THE

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THE PROGRESSIVE ELECTRICAL CONTRACTOR.

NOTWITHSTANDING all his troubles—real and imaginary—there appears to be plenty of room for profitable effort on the part of the progressive electrical contractor. The weaklings in the flock, for obvious reasons to which we have recently alluded, are less favourably placed for the display of enterprise of the kind we mean, for this reason, if for no other—that they are so busily engaged trying to make their own wage income out of the price-cut job, that they cannot personally leave it to go seeking for other work. We have no desire to ruffle the feelings of those who follow the new calling of illuminating engineer, for we hear much concerning the electrical incapacity of architects and some others whose errors of omission live after them in their jobs as much as do their sins of commission. The illuminating engineer, then, has his justification so far as we are concerned; indeed, judging from the illuminating effects obtained in many public and other buildings to-day, he or somebody filling a similar *rôle* is essential. Electricity has everything to gain from an efficiently laid out house-wiring system, and in the midst of changes over to metal-filament lamps, surely we ought to find an excellent opportunity for leading many consumers to see the advantages of re-arrangement of their points, &c., so as to secure the maximum illuminating efficiency according to the character and purpose of the premises. Those electrical men who term themselves illuminating engineers should take every reasonable means to drive home the necessity for change where it really does exist, but it will be only harmful to advocate changes for the mere sake of doing so—the advantages to accrue must be approximately in proportion to the work undertaken.

But where does the electrical contractor come in? He will in all probability be called upon to work out the scheme of the illuminating engineer, and he may, *inter alia*, have to put in gas lighting at that individual's dictation because he regards that illuminant as the more correct for a particular room or building; but has he no initiatory interest of his own? If we are not very greatly mistaken, he has very large interests if he be a progressive and fairly substantial contractor. It has often been pointed out that electrical contractors, as a general rule, have neither the organisation nor the capital necessary to undertake widespread canvassing for work, but the electrical contractor is called in dozens of times a week to put this, that, or the other detail right in connection with wiring work, and on such occasions he has opportunities for diplomatically indicating improvements which might be undertaken for the better lighting of the premises, and for the reduction of the consumer's quarterly account.

We seldom hear nowadays of electrical consumers returning to gas, and we should have heard less of it than we did a few years ago—before the days of metal-filament lamps—if

experienced electrical men had had an opportunity of showing the consumer how he could get at once a more satisfactory and more economical effect by a more judicious placing of his lamps. Of course a badly designed and fitted installation ought never to have been put in at all; that, the origin of the trouble, was, perhaps, the fault of a jerry wiring contractor who put lamps anywhere without scientific consideration. We do not want to see every mushroom contractor making suggestions for rearrangement of work put in by other and better firms; but it seems to us that contracting firms of standing, having on their staffs electrical engineers who have made a study of the scientific distribution of illumination, might do good work for the industry, because it is good both for themselves and for the consumer. We say a lot about the "Satisfied Consumer" to-day. Then let us see that he is satisfied. Let the contractor see to it, the illuminating engineer scheme for it, the central-station engineer and the lamp-maker work for it too.

It may be thought that the consumer's suspicions will be aroused by one contractor reflecting upon the work of another. This is a matter calling for the exercise of great discretion and tact. If the interview be diplomatically directed the consumer himself will soon be led to provide a convenient peg whereon to hang some useful criticisms and suggestions. It is possible to suggest improvements without reflecting openly upon the man who carried out the original work. It is even possible to justify the action of the original worker, but to show the supersession of his method by later experience. Our contemporary, *Electrocraft*, has lately been writing upon the "Contractors' Wider Field," and it mentions an interesting case which suggests at once the useful part that the electrical contractor can play if he grasps every opportunity as it presents itself, or, indeed, as he himself opens out the opportunity. A contractor was in a store making a purchase one evening, and in the course of conversation with the proprietor he learned that he had about decided to substitute gas for his electric lights. As the contractor critically surveyed the old-fashioned equipment, consisting of a helter-skelter assemblage of dull carbon-filament lamps, he was quite prepared to endorse the warm remarks of the disgusted storekeeper on the quality of his lighting and its unreasonable cost. But he was a bright, up-to-date contractor, and saw that an unexpected opportunity had come to him. He procured from the storekeeper a promise to take no definite step gas-ward for the present, and on the following day he laid out a plan for the illumination of the store. This plan he carefully explained to the doubting storekeeper next evening, and finally gained a reluctant consent to try it on. The old equipment was speedily replaced by tungstens of 100-watt and 40-watt capacities, installed with due regard for correct illuminating principles, and the gratified storekeeper found himself in possession of the most attractively lighted business place on the street, and with a meter bill somewhat smaller than he had been accustomed to pay. The contractor, needless to say, was equally well satisfied with what the job had brought him.

Our contemporary, whose remarks were intended to apply specially to the States, says that immense opportunities for business lie ready to the hand of every progressive contractor, and no "live" and sufficiently trained man need be short of work of such a kind. "The land is full of lighting equipments installed in the days when the contractor was rather more concerned about the number of outlets the job would stand for, than their proper arrangement, and when illuminating engineering was undreamed of by men." There is said to be about 20 years' accumulation of badly-planned, wasteful, and thoroughly unsatisfactory installations waiting for the contractors who possess enterprise and a sufficient knowledge of illuminating principles to be able to detect with reasonable accuracy and certainty what results may be confidently expected.

From what we have ourselves seen and heard, we are inclined to believe that these comments are equally applicable to the position of things in this country.

The various electricity supply companies have recently been telling their shareholders of the effects of metallic-filament lamps upon their output and revenue during 1909. They are to be congratulated in most cases upon the consequences not being more serious than they have been; the securing of new consumers, further development of power and heating supplies, and economies in the cost of production, have all assisted to mitigate the evil effect. But the movement appears to be only halfway through yet, if we judge from some of the statements, and for another two years the change-over will be proceeding, giving the contractor opportunities for introducing other improvements besides lamp substitutions. It is astounding to us sometimes to observe important buildings in the city of London where large numbers of carbon-filament lamps are still used. The economy possible in a restaurant basement where the lights are going for many hours a day is very considerable indeed, and why the change is not made we cannot understand. Is it the electrician who does not suggest the economy, or is it that his superiors do not see the benefit that would follow in the quarterly account? We have heard of places where the latter sort of thing has continued for a long while—to the annoyance of the electrician, and to the advantage of the electricity supply authority. But for such cases as these, we are sure that the electric lighting companies and municipalities would have suffered more than they have done.

We gather that the companies are in some places observing a desire on the part of consumers to have a more brilliant illumination in their homes and offices rather than to worry their heads seriously about economising in their energy bills. This is, we suppose, a course along which we shall all surely proceed in time. Our habits in such matters, speaking generally, have more influence upon our lighting bills than do our anxieties regarding economy. Here the lighting authorities will gain in the long run, as well as by the growing tendency to install electricity in all the rooms of a house instead of in only the principal ones, as in the past.

We have ventured the foregoing remarks as the directions indicated seem to point the way to more work for some contractors who are needing it, if they will proceed along proper lines to secure it. The lighter afternoons and evenings are here—though the dark times are not too far gone for the importance of the electricity bill to lose its significance—when re-arrangements of installations might more conveniently be proceeding in readiness for the next winter.

About a Winnipeg Contract.

We are afraid that any preferential treatment that Canada accords to British electrical and engineering manufactures under the heading of tariffs is not going to be of very much value for certain classes of contracts, unless fair consideration is meted out to the tenders submitted by our firms. We should have supposed that with the great developments that are proceeding in that country just now there would have been no need for the spirit of the green-eyed monster to be shown for the protection of Canadian electrical firms. It seems, however, that though the preferential tariff treatment is intended to represent the Canadian desire to give British manufactures a better chance than those issuing from other countries, it does not assure for the British manufacturer any consideration when his tender is being compared with those of firms having factories in Canada, however foreign they may be in some respects. In England it takes a long time for a foreign company establishing works here to be actually regarded as a quite British concern. It may be that the process is not so slow in Canada. We have repeatedly advised Britishers of the activity of the manufacturers and investors of the United States in catering for the electrical requirements of Canada, and their long establishment there undoubtedly secures for them a network of influence, and an amount of local knowledge, which must place them favourably, whether they quote low or not, as compared with our own firms who are now endeavouring to secure a share of the contracts that are open. We are not so unreasonable as to desire, let alone suggest, that the British tenderer shall have better treatment than the Canadian tenderer when prices are the same, in spite of the duties imposed on the British exporter. But when his price is lower or his manufactures are more suitable for the purpose in question, we expect our cousins to place contracts where the best results for that particular job will be assured.

We have already asked that in cases where there is no pressing urgency, greater consideration be shown to the British tenderer when fixing the closing date. When we have a cheap telephone service across the Atlantic we may be able to do differently, but as things are, a good many days are occupied in the post when matters require to be referred home, as they sometimes must be. Only British firms having a complete organisation, staff and establishment in Canada can hope to effectively compete with American offers, unless this greater consideration be shown.

We hope that British electrical tenderers will not be unduly disheartened because they have not succeeded in carrying off all the contracts that, on a mere price basis, they might have hoped to secure. We do not know whether certain prices have been quoted purely for the purpose of getting well established there, but whether they were or not, and though they did not actually bring work to this country, they have sufficed to demonstrate that British manufacturers are not far out in their ability to produce at commercially competitive prices for the Canadian market. For a complete hydro-electric equipment at St. Thomas, Ontario, a well-known English company cut in between the tenders submitted by the two leading Canadian electrical manufacturers—the General Electric and the Westinghouse—and was lower than the higher of them by $600 and only higher than the lowest by $277 on an $18,170 contract. But the lowest offer was accepted.

There now reaches us, through our London contemporary, *Canada*, interesting information regarding the amounts quoted by British tenderers for the Winnipeg power plant contract, and the treatment that has been accorded them. For this work there were English tenders which were substantially less than the Canadian quotations, but those responsible for recommending acceptance selected a Canadian tender ($116,500), which was nearly $5,000 more than the figure quoted by Messrs. Siemens Bros., and nearly $30,000 more than that of Ferranti, Ltd. ($89,856). Three tenders out of six were selected by the power engineers, so that two Canadian, and one English (Siemens), firms were in the running. One of the Canadian tenders was finally recommended "largely on the grounds of sentiment, caution and conservatism." These are three important words, the significance of which, in connection with this particular contract, we may only imagine at so great a distance from Winnipeg. But let us see, as far as we can from the available explanation, by what process of reasoning the anti-English decision was arrived at. We will quote a Winnipeg journal, as cited by *Canada*:—

"The power engineers reported that they had eliminated all but the first three, owing to insufficiencies, light equipment, and disregard of specifications."

This may all be quite warrantable.

"The highest tender was also eliminated, as it offered nothing superior to the other two."

This, too, may be perfectly reasonable.

"According to the engineers, there was not much difference between the Westinghouse and Siemens tenders. The overwhelming reasons for preferring the Westinghouse tender were: the advantage of having similar equipment to that ordered for the generating station, the ease with which operating men could familiarise themselves with the system as a whole, and the greater ease of securing parts and expert advice. The Siemens tender, on the other hand, was lower, but this would be somewhat off-set by increased cost of inspection."

Must we, then, deduce that for a Canadian power station where Canadian plant is installed no British followers will be allowed? If so, it will be waste of time to tender. Would the increased cost of inspection in the English case have been $5,000?

"After all, the engineers said in their report, the selection in favour of the Canadian tender was largely on the grounds of 'sentiment, caution and conservatism.'"

"These three, and the greatest of these is"—sentiment? Anti-English sentiment? When the matter came before the consulting board, they found that the difference between the Canadian and English tenders did not represent the value difference, "as there would be an extra cost of inspection and expense in the terminal station to fit in the Siemens switching, thus bringing the two to practically equal terms." Because of operating advantages in having equipment in the terminal and generating stations from the same company, the Westinghouse tender was preferred.

It will be observed that the reasons alleged for the preference exhibited for Canadian plant partake of the nature of excuses, and are shifty and halting at that. We are told that the "overwhelming" reasons were certain technical considerations, which, to a technical man, are shallow in the extreme; later, we learn that the selection was "largely" on certain other grounds, of a psychological nature, vague and ambiguous. Which of these statements—if either—is correct? *Qui s'excuse s'accuse*—and it seems clear that our friends have qualms of conscience.

Returning to the technical objections for a moment, the first is purely fanciful. The Underground Electric Railways Co. of London, in putting down an immense installation under the guidance of an American engineer, selected Westinghouse generating plant, and B.T.-H. switchgear. The London County Council has three different makes of generating plant in its 30,000-kw. power station, and five different makes of sub-station transforming plant in its sub-stations, to say nothing of switchgear. We could multiply such instances indefinitely, but it is needless—the first advantage claimed is purely hypothetical and imaginary. The second is bound up with the first, and is equally illusory. As for the third—do our Canadian brothers rely upon the manufacturers of their plant for expert advice? If so, wherefore do they issue specifications? And what becomes of their own claims to be able to discriminate between the merits of the rival tenders? But the position is untenable, the arguments fallacious and mutually destructive. We have considered the reasons alleged, and find them all wholly unsatisfactory.

A writer in Wednesday's *Times* remarks that "Canadian buyers have certainly not given British manufacturers and contractors quite equal treatment as compared with American firms." So we (in the Mother Country) receive preferential treatment as regards tariffs, while Americans receive advantageous treatment in other and, we fear, more vital ways, more than nullifying any benefit accruing from the lower tariff. We trust that this is but a passing phase, and that the friendly protestations of our brothers may in future be supported by their actions.

D

GAS-TESTING STANDARDS.

From the point of view of the consumer, not the least of the advantages of electricity over gas lies in the fact that the unit by which these commodities are sold conveys a much more precise statement of value to the purchaser of electrical energy than to the user of gas. The amount of light and heat, or its equivalent power obtainable from a given number of watt-hours supplied at standard pressure, depends entirely upon the efficiency and method of use of the consuming lamps and appliances, whereas the results of burning a unit quantity of gas are largely influenced by its composition or purity relative to the standards for which burners and engines are designed.

The fact that gas may be varied in composition, and that its value as an illuminant does not necessarily correspond with its efficiency for heating and power purposes makes it desirable for users, and those authorities who should safeguard the interests of users, to consider the need for closer and more scientific methods of checking the production of the gas suppliers than were found sufficient when the flame or non-atmospheric burner was exclusively used, and the development of gas cooking and heating had not reached its present importance.

The Acts under which the majority of gas undertakings at present work provide only for a certain standard of illumination being reached, usually from 16 to 20 c.p., when the gas is burned in a prescribed burner of the Argand type, official tests being made by an independent gas examiner appointed by the local authority, during the usual evening lighting hours, after notice has been given to the gas suppliers.

A recent Parliamentary Commission appointed to consider the subject of gas testing, has proposed the use of a new standard burner, which is officially described as the "Metropolitan Argand No. 2;" this is now prescribed by Parliament in the Model Bill, and has become obligatory in the case of some 50 gas undertakings, whilst a large number of the remaining companies have decided to promote a Bill to enable them also to adopt it. In view of this, it is of interest to examine the probable result of the change and the attitude adopted towards it by certain authorities.

In the new burner the gas is more efficiently consumed, with the result that a higher illuminating value can be obtained, or conversely, the original standard of light can be secured with gas of a lower illuminating power. It appears to be generally understood that the latter course will be adopted, thus enabling the companies to reduce their working costs by supplying a lower-grade gas, which, presumably, will not be detrimental to the users of incandescent burners, or, at the most, only entail adjustment; but the light given by flat-flame burners will be reduced, and in view of the great number of the latter in use, and likely to remain in use in houses of the poorer class and in positions where, for various reasons, the incandescent mantle is unsuitable, it appears that a loss to the community will result from the change, and that some compensation should be given. To this end several suggestions have been made, the simplest being a reduction in the price of gas of a few pence per 1,000 ft. It would appear, however, that a better bargain could be made for the consumer generally by insisting on the calorific power of the gas being kept up at all times. The considerable use of gas engines and the ever-increasing consumption of gas for cooking stoves and general heating renders it very important to the user, and, indeed, to the best interests of the suppliers, that the utmost value should be given in this direction.

The new testing burner is said to realise from 1·75 to 2 candles more illuminating power than the old, and assuming that the gas is reduced in power proportionately, where the standard has been 16 candles, the reduction would be about 12½ per cent., but a rebate of 2d. on 2s. 6d. per 1,000 ft. amounts to only 6½ per cent., the gain to the supplier being greater than the difference between these figures owing to the general tendency to burn more gas and the economy to be effected in fuel and treatment at the works.

Although the relation between the illuminating and calorific power of gas is not very definite, it may be taken that a decrease in the former will be accompanied by some reduction in the latter; the use of water gas as an adulterant certainly lowers heating power. Any provision for securing the quality of gas for heating and power needs to be accompanied by an extension of the prescribed testing times to any hour of the day or night to cover the use of stoves and engines during daylight hours, and other points of importance are:—To prescribe the type and manner of use of the photometer or calorimetric apparatus used at the testing stations, as since the standards in general use were first legalised, great improvement has been made in scientific apparatus and many of the photometers now used for gas testing are susceptible of large errors. Control over the injurious effects of the waste products of burnt gas apparently cannot be secured, the restrictions which were originally imposed upon the amount of contained sulphur have been removed, apparently owing to the danger and nuisance caused by the processes necessary to purify the gas. With the exception only of sulphuretted hydrogen, the impurities cannot be checked, although they cause great destruction of property, and have a most injurious effect upon those who use gas lighting in unventilated places.

Most of the above considerations have been dealt with in the Gas Light and Coke Co.'s Act of 1909, some of the provisions of which might serve as a model to those who, whilst not wishing to oppose the gas suppliers in any effort to secure more up-to-date and uniform methods of working, yet desire to make the best bargain possible for the consumer.

In the Act cited, the Gas Co. sought certain extensions of its powers, and also to reduce its standard of illumination from 16 to 14 c.p. As a result of opposition by the L.C.C., clauses were inserted providing that:—

"The calorific power of the gas should be 125 calories net per cubic foot, with a possible minimum of 112½ calories before any penalties be incurred. (Clause 39.)

"On any day when a further deficiency not exceeding 3 calories should be observed, a penalty of £5 be incurred.

"Exceeding 3 calories, and not amounting to 6 calories, £10.

"For each complete 6 calories, a sum not exceeding £20.

"The gas undertaking to provide testing apparatus at the public testing stations; such apparatus and method of using same to be as prescribed by the London Gas Referees.

"Tests of calorific power to be made at any hour of the day or night. (Clause 41.)

"The company shall, if and when required by the consumer, supply and fix, free of charge, burners suitable for the altered composition of the gas to replace those in use by the consumer on the date when the Act commences to operate, two years being allowed for this work in the case of consumers paying on the usual terms, and one year where prepayment meters are in use." (Clause 43.)

This last provision will remind electrical engineers of the free lamp changes and all the attendant troubles experienced when changing their supply pressure; unfortunately for the consumer, the gas supply to a whole district must be altered at the same moment, so that many users may experience the disadvantages of the lower power gas for some time before their burners can be altered, a point which the electric supply departments will hardly fail to take advantage of.

It may well be asked whether the gas undertakings, which are almost uniformly prosperous, are acting wisely in lowering the quality of their product in any way, particularly in regard to heating, which promises to become the mainstay of their business, and provides them with a long-hour demand, which, if less important than in the case of electricity supply, must to some extent simplify their engineering problems, particularly on large systems.

This attempt to secure lower working standards has apparently been made possible by the incandescent burner, and finds a parallel in the already-expressed desire of certain electric supply authorities for a widening of the present Board of Trade limits for supply pressure. In view of the characteristics of the metallic-filament lamp, when increased lighting business has again loaded up the mains systems which, in so many cases lately, have been free from pressure troubles owing to the extensive replacement of carbon by metallic lamps, it may be hoped that some concession will be made with regard to supply pressure, the

present limits of which might be exceeded without appreciable detriment to the consumer and with a real advantage to the capital charges upon the supply undertakings, particularly on large lighting systems, where expenditure on mains forms an important item in the costs of supply.—J. W.

ALUMINIUM AND ELECTRICAL CONDUCTORS.

[COMMUNICATED.]

In view of the persistent rumours of a great copper combine which shall put up the price by regulating the supply of this metal, and seeing that aluminium can now be produced on a scale which allows of its competing with copper, a few notes on the subject of aluminium electrical conductors may not prove unacceptable to those concerned with electrical lines of one type or another.

To obtain a definite relation between the claims of copper and aluminium in this connection would, we suppose, mean the employment of a formula, even more complicated than that quoted in the text-books relating to the most economical form of conductor. Some plain comparisons will probably be of more utility at the present time to show the pros and cons of copper and aluminium, and their employment for electrical conductors. Copper, we should say, is at least not likely to go down much below its present level, and aluminium may yet be a little cheaper, but even under the present circumstances it will be found in certain cases that it is advantageous to discard the old material on the ground of cost, even if for no other reason. The fundamental bases of comparison for the two metals for the purposes of the subject under discussion, may be stated as follows :—

	Copper.	Aluminium.
Sectional area for equal conductance (or carrying capacity)	1	1·66
Weight for equal conductance	1	·502

That is, a 1 sq. in. copper cable would have the same resistance as an aluminium cable of 1·66 sq. in. sectional area, but in the same two cables the weight of the larger aluminium cable would be only approximately one-half that of the copper cable. Taking the 1 sq. in. cable as 91/·118 in., the equivalent aluminium cable would be :—

$$91/(\cdot 118 \text{ in.} \times \sqrt{1\cdot 66}), \textit{ i.e.}, 91/\cdot 153 \text{ in.}$$

It will be seen from this that for bare overhead lines where a single wire or a fair-sized strand is employed, with the prevailing prices of the two metals, and judging from the financial point of view only, the odds are in favour of aluminium so far as the line material itself is concerned. Another fact in its favour is that existing poles can be utilised when it is desirable to replace an old copper line by an aluminium one. As regards the suitability of aluminium for this purpose judged from the mechanical side, the tensile strength being less than half that of copper, it would appear to be at some disadvantage. As is well known, there are many aluminium lines in operation abroad, and some in this country, but from the experience such lines have given up to now, they do not appear to have been specially successful, at least in this country. Long spans are used generally. For telegraph wires carried on poles in large numbers, hard-drawn copper wire is, of course, beyond competition, because of its high breaking strain, and also because its small diameter hinders a heavy accumulation of snow—a not infrequent cause of breakdowns. In West Africa, we believe, aluminium has been used of late for telegraph wires, the jointing being effected by sleeves of the same metal, which are simply clipped to the wire by means of the ubiquitous pliers. The question of durability and long life under all sorts of conditions is one which, of course, can only be answered after more experience, but it is not unreasonable to suppose, from what is known of its behaviour and characteristics, that under average conditions it will not be inferior to copper. Under abnormal conditions of the atmosphere, copper is itself subject to deterioration, from which it would hardly be feasible to suppose that aluminium under like circumstances would not also suffer.

It is when considering the applicability of aluminium to insulated cables and wires, however, that one or two factors occur which somewhat complicate the matter. It will be found, we think, that while copper is not appreciably dearer than aluminium, the selection of the conductor is determined by the cost of insulation, and the question arises whether the increased cost of insulating the larger aluminium cable is more than balanced by the saving in the conductor. A high-tension cable of small section is costly by reason of the fact that it is heavily insulated and protected. The copper in the cable is small, because a high voltage is being used. The insulation and coverings, therefore, represent the greater proportion of the cost of the cable. In a low-tension cable, on the other hand, the insulation is not so heavy, and so the insulation and coverings cost less in proportion. If the diameter of the aluminium wire or cable is about 1·3 times that of the copper (for the same resistance), the cost of covering will be increased, and against this at present can only be set the fact that the cost of the conductor will be only about one-half that of the copper conductor. It seems, therefore, that if the insulation is one of the cheaper kinds, and the cable of a small order, requiring little covering, the alternative of aluminium may well be considered. Further, copper has only to go up to a price which it has seen within the last four or five years to allow aluminium to qualify for any cable, large or small. As regards the use of aluminium for electrical machines, it seems, on the face of it, as though the greater cross-section necessary to obtain the required conductance will prove fatal to aluminium for windings and kindred purposes.

The former difficulty of jointing now seems to have been overcome. Stranded conductors offer rather more scope for ingenuity than the single wire, some strands indeed having been jointed by clamping instead of by the sweating method. This it is said answers satisfactorily, and for small wires appears to be the general practice. When the natural conservatism of the Britisher is overcome and he takes to aluminium, whether it be soon or late, he will probably wonder, as he often does with other matters, why on earth he has not tried it before.

REVIEWS.

The Dynamo: Its Theory, Design and Manufacture. By C. C. Hawkins, M.A., M.I.E.E., and F. Wallis, B.A., M.I.E.E. London: Whittaker & Co. Price 21s. Two vols. Fifth edition.

The first volume, and part of the second, treats of direct-current dynamos in a most exhaustive way, and the rest of the second volume is occupied with alternators; for the authors call all machines which generate electricity "dynamos," and they distinguish between the two main types by naming them heteropolar and homopolar. Therefore, in what may be called the strictly direct-current dynamo part, there are frequent references to machines which give alternating current. The books are just right for students, for they give a correct view of the *whole field*, and yet at the same time they are also good books for the designer and draughtsman who wants to refer quickly to up-to-date information on a particular detail. The up-to-dateness may be judged by what the authors have to say about hysteresis in dynamo armatures; six pages are given to this hitherto obscure matter, and there is a further note on the influence of vibration and temperature on hysteresis.

About 14 pages are devoted to insulating materials, and the following are some interesting extracts :—

The action of lubricating oil on varnishes is that it unites with part only of the constituents of the varnish, and thence liberates free acids which attack copper, as evidenced by green discolorations. The paraffin non-acid varnishes are free from the liability to chemical resolution, since they unite wholly with the oil without losing their insulating properties; they are, however, difficult to dry and handle.

Linseed requires to be oxidised in order to dry it; therefore the advantage of the vacuum chamber, in drying without the application of great heat, is largely nullified, since air has to be admitted at intervals. Stoving is as effective and more rapid.

On the whole, for impregnating purposes, the balance of advantage may, perhaps, be said to rest with linseed-oil compounds. Linseed oil expands in drying, which is of advantage in closely filling the pores.

Armature reaction, commutation and sparking at the brushes are most thoroughly dealt with, and, truth to tell, the authors are such masters of their subject that one has to read very closely to follow them.

Sample designs of 80-KW., 165-KW. and 500-KW. dynamos are worked out in detail, and the important modifications required for steam turbine-driven dynamos are gone into.

The alternator section very appropriately starts with armature windings and armature reactions. The field magnets are then treated, and so on to general questions of design, paralleling, &c. Typical alternators made by the leading firms are described in detail.—E.K.S.

Electric Traction on Railways. By PHILIP DAWSON, M.Inst.C.E. London: The *Electrician* Printing and Publishing Co., Ltd. Price 25s. net.

This volume, which contains upwards of 900 pages, covers the whole range of electrical traction as applied to railways, detailed information being given on the single, three-phase and continuous-current systems. In a volume of this description, it seems a pity that controversial matters are not left alone; such sentences as the following, which appear in the preface, discredit the whole profession, and may do considerable injury to the progress of the electrification of railways:—"As sometimes happens in such cases, many of those who have entered the field of controversy in electric traction, and who have been most bitter, cannot be considered entirely disinterested or unbiased." Again we have:—"It is but natural that the successful designer of continuous-current apparatus, who in early days developed the continuous-current motor for electric traction . . . . should feel tempted to unfavourably regard a new departure with which he has not been personally associated, or which threatens to render obsolete many of the most brilliant products of his mind, &c."

It is difficult to believe that any competent engineer would take up such an attitude, especially after mature consideration, and the discussions which have so far taken place cannot be said to have been between alternating and continuous-current men, so called, but between men who are recognised as good designers of both classes of machines. It is evident also from the discussions and correspondence which have taken place that each honestly puts forward what he thinks is the best solution, the discrepancy between their views being due to the fact that the respective parties are considering propositions which are not analogous. There is no question that the engineer examining a scheme would give a decision only after a thorough investigation of both systems, just as the author has undoubtedly done in connection with the electrification of the L.B. & S.C. Railway, and surely no one doubts that he has done the right thing.

The volume opens with a brief historical *résumé* and some general considerations, an improvement on many works that devote much valuable space to early electrifications, which have long ago ceased to be of material interest, and are consequently ignored by the reader. The author, however, and rightly, lays particular stress on the conclusions arrived at by the Royal Commission on London Traffic as regards railways—conclusions which the companies do not, unfortunately, seem anxious to follow. In the second chapter elementary definitions are first taken up, and later the best acceleration for any service is fully and clearly discussed, while Chapter III gives a very clear explanation of how "running curves" are obtained, and also investigates the effect of the revolving masses which play so important a part in high-speed work. The single, three-phase and continuous-current motors for railway work are fully described in Chapter V, which also contains some useful tables and characteristic curves, particulars being given of the Winter-Eichberg motor which the author has adopted on the L.B. & S.C. Railway electrification.

The high-voltage continuous-current motor is somewhat cursorily discussed. In view of the fact that it is now largely used in the United States, some dozen lines being already equipped, it is entitled to a somewhat fuller treatment; there can be little doubt but that this motor has a considerable field before it.

Chapter VI is entirely given up to the determination of resistances for continuous-current motors, an example being worked out for a G.E. 66A motor. The plain series single-phase motor of the Lamme type, the Winter-Eichberg compensated repulsion motor and the Alexanderson motor are treated of in an elementary manner in Chapter VII, mention being made of Mr. Atkinson's pioneer work. In Chapter VIII the design of axles is gone into in a very exhaustive manner, and tables are given showing the analysis of nickel-steel axles. Chapters IX and X deal with trucks and bodies, the former also including a set of diagrams showing various types of brake rigging, among which are the designs used on the motor and trailer coaches on the L.B. & S.C. Railway, while the latter gives a considerable amount of useful data on English, American and German bodies.

An excellent and well-illustrated description of the various methods of control, both for continuous and alternating-current equipments, is given in Chapter XI, while Chapter XII is devoted entirely to the electric locomotive, the information given being exceedingly useful. Train resistance is covered by Chapter XIII; Mr. Aspinall's table, which includes all well-known formulæ, is reproduced in full. Chapters XIV and XV are confined to the development of formulæ for the voltage drop in return circuits and earth and track return currents, Mr. Parry's well-known results being obtained by a new method.

Third rails and collector shoes are described and illustrated in Chapter XVI, which also includes a very useful table giving the rails used on various systems together with their chemical compositions and electrical resistances. All types of overhead work are fully described and profusely illustrated in Chapter XVII, which is followed by a chapter giving the theory of the catenary.

Chapter XIX enters fully into the design of collectors, and complete information is given of the Westinghouse, Siemens-Schuckert, A.E.G. and Oerlikon collectors; the author's new design for the L.B. & S.C. Railway is also described and illustrated. The most economical size of feeders, the effect of load factor, and some data on aluminium cables are covered in Chapter XX.

The "Power House" is briefly discussed in Chapter XXI. Typical lay-outs are given, together with data regarding the floor space occupied per kilowatt by turbines and reciprocating engines. Continuous and alternating-current sub-stations are examined in Chapter XXII, diagrams of connections of switchboards and some typical lay-outs being given. Boosters and storage batteries and accumulator systems provide material for Chapters XXIII and XXIV, the latter describing a coach which is run on the suburban lines around Mayence, it is said, with excellent results. Raworth's regenerative system is fully described in Chapter XXV, as well as regeneration with three-phase and single-phase motors. The concluding chapters deal with repair shops and maintenance, and the very important financial results.

The volume contains a very large number of minor errors, which should have been detected and corrected when the proofs were read over; for instance, planimeter is spelt planometer, root is printed for route, steel for steal, burned for burred, &c.

Some of the cuts and diagrams are wrongly referred to in the letterpress. Thus, on page 40, the reference fig. 3 should be fig. 7; fig. 542 is stated to be an output curve of one of the sub-stations of the New York Central, yet underneath the curve it is called "Typical week-day load of 59th Street Power Station;" the boilers in fig. 546 are called B. & W. land boilers, whereas marine boilers are shown. In describing the mechanical brake on the Mayence accumulator coach, reference is made to fig. 588, which is the diagram of connections of the Pirani booster; it should be fig. 594. The photograph of the Simplon three-phase locomotive, fig. 288, is reproduced in the same view in fig. 520. Incorrect mathematical symbols are of frequent occurrence; on page 108 the speed of a polyphase motor is given as $\text{R.P.M.} \times \frac{\text{frequency}}{\text{pairs of poles}} \times 60$. The bracket in the ex-

pression on the top of page 202 is in the wrong place, and again in the expression in page 453, while an "h" is missing from the formulæ on page 465. In speaking of the Metropolitan District Railway on page 522, it is stated that the positive rail averages 450 volts to earth, and the negative 150 volts per unit, whatever that may mean.

Some of the expressions used are exceedingly lax; for instance, "the conductors are all in series around the commutator"; again we have, "had the armatures rigidly wound on the wheels," and "the armature can be wound on the axle."

On page 679, although it is stated that the safe current is a function of the material and thickness of the insulation, yet a final temperature of 150° F. is given, which evidently refers to paper-insulated cables only. The above errors are typical only, there being many more of a similar nature, which it is hoped will be corrected in the next edition.

Taken as a whole, the book is certainly above the average, and contains a mass of detailed information, much of which is practically unobtainable elsewhere, and is extremely valuable to an engineer who has the electrification of a line in hand. The value lies, not in the theoretical discussions, but in the enormous amount of detail of existing lines that has been brought together, and in the diagrams and photographs, there being over six hundred illustrations. Mr. Dawson can certainly be congratulated on the work he has produced. It must have entailed a vast amount of labour, and, judging from the investigations he has made in connection with the L.B. & S.C. Railway, the results of which are collected together in this volume, it should be of great value to railway men in all capacities. In addition to the general index there is also an index for the illustrations. Moreover, the printing is excellent. But what a pity the work is not in two volumes.

Practical Alternating Currents and Alternating-Current Testing. By C. F. Smith, M.Sc., M.I.E.E. Manchester: The Scientific Publishing Co. Price 6s. Third edition.

In discovering Mr. C. F. Smith as a writer of text-books, the Scientific Publishing Co. did a service to the electrical engineering profession. Anything he writes is thoroughly well put together, and the amount of data and experimental information which he has managed to crowd into the 450 pages is amazing. The first edition naturally contained misprints and omissions, but in the present edition these have been rectified. The book well deserves to become the standard for all laboratories and test rooms, not only in this country, but also abroad. The experimental results have in the majority of cases been obtained expressly for the book, and the author gives Mr. V. A. Oschwald, B.A., due credit for assistance in this.

In order to make room for new matter a good many sections of the earlier edition have been condensed, especially in the case of transformers and alternators. In the chapter dealing with the latter, the author describes two ways of carrying out tests which he calls the *pessimistic* and the *optimistic* methods. With the pessimistic method the armature current is assumed to produce no reaction flux, and the voltage drop is assumed to be entirely due to the resistance and reactance of the armature, the main field maintaining its value constant. In the optimistic method the armature reactance is assumed to be zero, and the drop in volts of the alternator is assumed to be entirely due to resistance and to the effect of armature reactions on the main field in the air-gap. The armature reactions are, therefore, taken greater than their true value, in order to account for the effects of reactance which are assumed not to exist.

The chapter on induction motors has been rewritten, and there is a new one on single-phase motors. The last chapter, on the composition of voltage curves, describes the oscillograph and ondograph, and it is the only chapter in which higher mathematics are introduced.

The diagrams and curves are particularly good.—E.K.S.

Practical Calculation of Transmission Lines. By L. W. Rosenthal. London: The McGraw-Hill Publishing Co. Price 8s. 4d. net.

The author is what the Americans call "a way up" in the matter of calculations. He has been the lightning calculator for one of the big companies, and so his examples are extremely practical, and his short cuts to results have about them the air of a hard-pressed estimating office.

Coefficients for the formulæ are set out in tabular form, and, more often than not, the references are to tables several pages ahead, so that one feels somewhat stunned at a first reading.

Here are a few of the questions from various sections of the book:—

(*b*) Find the size of a third-rail of relative resistance 7·5 (including bonding) required to start two cars taking 1,000 amperes at a point midway between sub-stations 8 miles apart, if the drop at 20° C. is to be 25 per cent. of the 600 volts at rotaries. Each track rail is to weigh 80 lb. per yard, and to have a relative resistance of 13, including bonding.

Required Items:—An 85-lb. rail; total drop, 148·7 volts; watts loss, 148,700. The calculations occupy 12 lines.

A three-phase load of 7,500 kw. at 90 per cent. lagging power factor and 60 cycles is to be delivered over 140 miles of three copper wires of 100 per cent. conductivity on 96-in. centres; the voltage loss to be 18·7 per cent. at load, and the voltage at the source to be 71,200. Include the effect of capacity and assume a temperature of 20° C.

Required Items:—Size of wire, No. 00 A.W.G.; voltage loss, 17·2 per cent.; power loss, 13·3 per cent.; kw. at source, 8,500.

The working-out covers little over a page, and this problem, it may be mentioned, is based on one by H. Pender, in *Proceedings* of American Inst.E.E., June, 1908, p. 774.

A 25-cycle single-phase car starting 8 miles from a transformer station giving 6,600 volts, takes 500 kw. at 80 per cent. power factor from a circuit consisting of two 70-lb. rails and one No. 000 trolley wire.

Required Items:—

Volts loss	8·3 %
Amps.	103·0
Power loss	7·2 %
kw. at source	536

Several facts brought out incidentally in the text are interesting. Thus, the power factor of the track of a single-phase railway working at 15 cycles is about 65 per cent., and at 25 cycles it is about 55 per cent. Catenary wires usually help to carry the current, but their skin effect prevents them from taking more than about 10 per cent. of the current.

Of course, all sizes of wires are worked out in that American abomination—"circular mils." However this system managed to get a hold on such utilitarian people is past comprehension. It cannot be any saving in time to string out five or six figures in circular mils when two or three will do if it is given in a decimal of a sq. in. It is also no aid to memory, whereas the English system is handy in that way; for example, a No. 16 S.W.G. wire is $\frac{1}{16}$th or ·064 of an inch in diameter and ·0032 sq. in. area, and a No. 10 S.W.G. wire is $\frac{1}{8}$th or ·128 of an inch in diameter and ·0128 sq. in. area. The nearest circular mils to these two sizes are 4,107 and 16,510, and who is going to remember such figures?

There are quite a number of people in this country, to say nothing of the daughter nations, India and the Crown Colonies, and 99·999 per cent. of them don't know what a circular mil is, and what is more, *they never will learn*; square inches are good enough. Well, now, Mr. McGraw from time to time publishes books which are quite good, but unfortunately they are full of circular mils. Being an American he wants to sell his books, and there are plenty this side who would buy them, but there are those abominable circular mils, and, well—life is *so* very short.

If our American cousins feel like arranging anything of the same kind again, it would be good business policy to ask mother and her daughters about it first. We have a prejudice for good old Anglo-Saxon words and measures.—E. K. S.

ELECTRIC TRACTION ON MAIN LINE RAILWAYS.

It is a satisfactory sign that the discussion on the everlasting subject of electrification of steam railways is tending towards the financial aspect of the subject rather than to the question of what is the best system. This is a distinct step in the right direction, for, after all, electrical engineers are not likely to exert much influence on railway directors and officials while they confine themselves to demonstrations of the advantages of particular systems. On the contrary, if there had been as much information put forward of a commercial character as there has been of a technical nature, we think that the question of electric traction would have been in a much stronger position than it is to-day.

There have been two recent contributions to the almost overwhelming mass of literature on the application of electricity to railway working, which deserve some notice in that a very distinct attempt is made to put the subject wholly on a commercial basis; we refer particularly to an article by Mr. F. Darlington in the *Engineering Magazine* on the "Financial Aspect of the Application of Electric Motive Power to Railroads," and to an address by Mr. L. R. Pomeroy on "The Electrification of Trunk Lines." It is clear from the titles that the two authors take a more ambitious view of the question than is usual at the moment, for there has been a general consensus of opinion that the electrification of main lines is too remote a problem to enter into one's serious calculations at present. Yet it is not desirable to take too much for granted, and it would be a fatal error to assume, because electricity would appear to present no immediate advantages under the present system of working long-distance traffic, that radical alterations in railway methods—which, after all, may not be very remote—would not open up great possibilities for electrical working. The axiom which we presume is implanted in the minds of railway officials—that railways create their own business—may have an overwhelming application when the advantages of electricity are fully realised. The attitude of the railway world towards electrical systems may be not altogether unreasonable, in view of the information which is at present available. In 1907 the chairman of the Great Northern Railway, Lord Allerton, pointed out to the shareholders that their very large suburban traffic had been seriously affected by electric tramways. Six months later he again deplored the decrease in the suburban receipts, and stated "it was of no use lamenting over the loss of the short-distance passengers. The directors knew of no remedy for it; they were now being carried at less than cost in many instances, and they had got to face the difficulty as best they could." An equally dismal picture was drawn by Lord Cottesloe, the chairman of the London, Brighton and South Coast Railway, at the general meeting in 1907, at which it was pointed out that the decrease in passengers was 2,153,362; an analysis showed that the greater part of this decrease was in respect of short journeys, which proved the accuracy of the statement that tramway competition in and around London was largely responsible for it. But mark the sequel. The Brighton Co., instead of continuing to lament the falling-away of traffic, resolved to meet the conditions by electrifying the line from London Bridge to Victoria, *viâ* Peckham Rye, and though the system has been in operation only since the beginning of December last, Lord Bessborough, at the meeting of the company held at the beginning of February, in speaking of the results of electrification, stated that "the traffic results showed that in the first two months of electrical working they had got back nearly the whole of the lost traffic on that section, and naturally those results had led the board to think of the advisability of extensions."

While Mr. Darlington is mainly concerned with conditions prevailing on American railways, there are certain general conclusions arrived at which have equal application to English railways, a specific point being that notwithstanding the enormous variety of traffic facilities offered by steam railways, the demand for cheap haulage is not met. It is computed that on one of the large railways in the United States, the cost of carrying freight to and from the depôts is greater than the gross earnings of the system. In spite of this, however, the apparent tendency of the railway systems is for them to become more and more carriers of heavy traffic, and to neglect local carrying, notwithstanding that local hauling by wagons costs something like 25 times as much as railroad hauling. The argument of the author—and it is one with which we are in entire agreement—is that local hauling can be done only by electrical means, and the thousands of miles of electrical lines have demonstrated by actual operation the wide field for profitable electric railway business. The attitude of many railways is summed up in the following sentence:—"Steam railroads use every means possible to save a cent on long hauls, but in a majority of cases they have consistently neglected the great opportunity afforded by electric power to furnish profitably more and better local accommodations."

The author, speaking of the definite application of electricity to main lines, admits that there is too wide a variety of conditions to permit of a specific statement defining the comparative economy of steam and electric power for moving heavy trains for through business. This work requires locomotives and not motor-cars, and for such work the question is chiefly that of the relative cost of locomotive service by electric power.

In the few instances where electric locomotives are being operated on main lines they are proving economical and effective. It must be remembered, however, that where electricity is being employed on main lines there are special conditions obtaining which are distinctly favourable for electric locomotives, and there is, after all, no very great length of line which is being thus operated. But as far as they have been adopted, the results are excellent, and it is upon these figures that the author puts forward a plea for a larger extension of the sphere over which electricity can economically operate. A good deal is made of the increased capacity to handle traffic, and the great increase of track and terminal accommodation obtained. The chief advantage of an electrically-operated main line must be in fuel economy, but the varying price of coal in different parts of the country at once emphasises the difficulty of drawing any definite conclusion in regard to the advantages of electricity over steam. Mr. Darlington quotes the very careful analysis of coal consumption that was made on the New York, New Haven and Hartford Railway, which showed that the saving of fuel by electric operation on the express service was 51 per cent., the express local service saving 54 per cent. and the express freight service saving 26 per cent. Some time ago Messrs. Stillwell & Putnam gave the estimated saving in fuel by electric operation as 49½ per cent. for average railroads in the United States of America.

Fairly substantial claims are put forward for the great saving that can be effected in repairs and maintenance with an electric system, but, unfortunately, while there are abundant statistics regarding steam locomotives, there is obviously a lack of data as to the performance of electric locomotives.

Many authorities, however, have computed that the cost of maintenance in the case of electric locomotives would be about half that of steam, and as the available figures show that steam costs from 1·3d. to 4d. per locomotive-mile, this is, perhaps, not an unfair assumption; at the same time, it would be unwise to put too much reliance on such figures. In summarising the conditions favourable for electric traction on main lines, the author gives them as follows: Where traffic is dense; where coal is costly; where electric power is cheap—particularly where cheap and reliable water-power can be secured. At the same time it is admitted that while under many conditions electric working on main lines would be an advantage, it is chiefly because the single-phase system has received a tremendous impetus during the last few years, and with large single-phase locomotives of great power there are many cases which could be effectively dealt with by electric traction.

Mr. L. R. Pomeroy, in his recent lecture before the Engineering Society of Columbia University, takes an entirely commercial view of the problems, and in the course of his address gives most interesting figures on both sides of the question in comparing the steam and electric locomotives.

He points out that in heavy work the limiting features of the steam locomotive are the boiler and the maximum adhesion capacity utilised at low speeds, but the electric locomotive occupies a rather different position. "As tractive force governs the tonnage hauled, the ability of the electric locomotives to utilise almost indefinitely power proportional to the maximum adhesion, and to produce a drawbar pull entirely independent of the critical speed of a steam locomotive as limited by the boiler, is a marked feature."

In regard to fuel economy, the figures quoted in the lecture are similar to those put forward by Mr. Darlington, and no doubt the origin is much the same. Greater emphasis is, however, laid on the stand-by losses of the steam locomotive. At the same time, while an exactly similar charge cannot be applied to an electric system, the mere standing idle of electric locomotives seriously affects the load factor of the system. The necessity for caution in the application of electricity to main line operations, however, is amply justified by some of the figures which are actually given to prove the case for electricity. Statistics have been quoted by Mr. de Muralt, who shows the saving that would be effected on the Pennsylvania and New York Central Railway; and though these figures amount, roughly, to 8 per cent., they would be materially whittled down when one took into consideration the extra capital that would be involved in making the change from steam to electricity. Mr. Pomeroy deals with some of the advantages claimed for electric locomotives, and points out that the ability of the electric locomotive to perform continuous service, compared with the limited area over which the steam locomotive can operate, is more apparent than real, for the simple reason that the "splendid ability to perform almost continuous service, cannot be utilised in practice." It is obvious that traffic limitations apply equally to the electric as to the steam locomotive. The power station capacity of an electric line, however, is one of its chief advantages, and it is particularly manifest in a case, say, which involves the use of 100 locomotives, for clearly the electric system would not be called upon to provide plant for the total of 100 locomotives but sufficient only to meet the average load. The striking advantage gained by electricity is shown where it is necessary to provide powerful locomotives to handle heavy freight traffic, for with an electric vehicle it is possible to develop a much greater horse-power and a large percentage of overload at a time when needed, and to do it more economically than with steam. The New York Central electric locomotive has a maximum peak horse-power of 3,000, which is about double the power which can be obtained from the New York Central Standard Atlantic type locomotives. The overload capacity of the electric locomotive, however, in the author's opinion, would make it applicable to special cases rather than a universal substitute in the broad light of commercial considerations, and while in the main one can hardly quarrel with such a conclusion, we seriously hope that railway authorities will not judge electricity solely by its immediate results, but that they will take the future prospects into consideration also.

In this respect we are inclined to disagree with Mr. Pomeroy, who declares that the future is too indefinite to be capitalised to any degree in advance. If this opinion had always found favour in railway circles, then we should have seen very little advance in railway engineering; indeed, there would have been no progress at all.

One of the difficulties which the whole question of electrical operation is confronted with at the present moment is the ease with which figures can be produced to show the futility of electrifying a given line, and Mr. Pomeroy is not sparing in his examples to prove that under many conditions electricity has no case. He quotes the Illinois Central to show that electricity would result in a deficit, but it is clear from the statement of the president of the line that this is no case for electrification for the simple reason that the suburban traffic is not dense enough. But such an instance proves nothing against electric traction, and the same remark applies to other instances quoted. When Mr. Pomeroy analyses the results of the electrification of the Mersey Tunnel line he, however, misses the whole value of electricity on that system. He points out that the net profit amounts to only 15 per cent., but that it took 55 per cent. increase in traffic to procure this result. He entirely overlooks the fact that under steam conditions traffics were rapidly decreasing, owing to the competition of the local electric tramway and ferry systems and other causes, including an abominable smoke laden atmosphere, but the introduction of electricity has completely changed all that, and in place of a decreasing there is now a rapidly increasing traffic. Surely there could be no better argument in favour of electrification?

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Contractor or Manufacturer?

I was deprived, through pressure of business, of the favour of saying a few words in response to Mr. Cramb's letter in yours of the 11th inst.

One cannot help discerning, through all this correspondence, a great deal of ill-feeling which, in my opinion, need never have existed if a more vigorous system of equity in conducting this business was adopted by the supply managers, against which system, apparently, station engineers firmly set their face, hence all this unnecessary squabbling.

It must be admitted that station engineers, for the most part, have not had a great deal of business training, and there is certainly room, to my own personal knowledge, for great improvements in the execution of this branch of business. Our own canvassing department has not for years been a success, man after man having to be discharged for one thing or the other; hence I consider the contractors have proved a useful adjunct in building up this business of ours, and this is no doubtful situation as implied by our engineer. I feel confident that the contractors of this town are as competent to-day for carrying on their business in a proper manner as they were before the institution of the publicity department. I am as anxious as our engineer to see things go forward, and will do my utmost to assist him; but, at the same time, I cannot see for the life of me why straightforward business cannot be adopted and an amicable feeling generally produced.

Leonard Stevens.

Croydon, *March 22nd*, 1910.

Publicity Literature.

With reference to the letter which appeared in your last week's issue, I note that your correspondent is prepared to make good his statements, so we take him at his word, and if he will kindly send, through the Editor, his name and address, we shall be pleased to pass him an order for showcards, printed in five colours, similar to and at the price named.

We would further suggest that "A Central Station Man" should communicate direct with the Publicity Committee, who would no doubt welcome an opportunity of securing his co-operation, and it is to be regretted that he did not take this obvious course in the first place in reply to the letters which, we understand, were sent out to all central station engineers prior to any orders for printing being placed. Meanwhile, we would add that, although criticised so unkindly by "A Central Station Man," the work of the Publicity Committee has, we are assured, been an unqualified success.

W. H. Smith & Sons' Advertising Agency.

London, *March 24th*, 1910.

The Price of Rubber.

We note in your issue of this week an editorial on the price of rubber, and the concluding sentences are, of course, of special interest to us as suppliers of ebonite for insulating purposes.

The increased price of raw materials has certainly affected us considerably, although we are pleased to say that we have found no falling off in the requirements of the trade. The advantages of ebonite as an insulator in the higher classes of work over other insulating material are so great, that although we have necessarily had to make advances in prices, we find that manufacturers are prepared to pay these advances sooner than use inferior material.

For ourselves, we have maintained our figures to the last possible moment, but the future prospect looks rather to advanced prices than to any reduction.

Carson & Evans.

London, E.C., *March 24th*, 1910.

The Single-Phase Motor.

Allow me to tender my thanks to Mr. M. I. Williams-Ellis for his reply, published in the ELECTRICAL REVIEW for January 28th, 1910, to my request for information on the subject of works driving by the "New Type of Cascade Induction Motor." I found the letter very interesting, and am much obliged to Mr. Williams-Ellis for writing so fully.

Advocate.

Straits Settlements,
February 25th, 1910.

ELECTRICAL FINANCE IN EUROPE.

THE principal German banks, in the annual reports which have just been issued for 1909, abstain from any reference to the 5 per cent. debenture bonds, series B, which were recently taken over from the Victoria Falls and Transvaal Power Co. to the amount of £900,000. An application for admission of these bonds on the Berlin Stock Exchange was recently made by the Deutsche Bank, the Dresden Bank, the Disconto Gesellschaft, the Bank fur Handel und Industrie, the Schaaffhausen Bank Verein and the firms of S. Bleichroder, Delbruck, Leo & Co., and Hardy & Co. This list is given in order to show how influential are the institutions which supported the placing in circulation of these bearer bonds, which are redeemable at the rate of 110 per cent., with the first redemption in 1917, and which are said to have been subscribed several times over.

The shareholders in the German Transmarine Electricity Co. (Deutsch-Ueberseeische Elek-Ges.), of Berlin, have sanctioned the raising of the ordinary share capital from £4,000,000 to £4,500,000, to which reference was made in a previous issue. As explained by the chairman at a recent meeting, the increase is solely intended for the purpose of consolidating the floating debt, and certain of the proceeds will be devoted to the repayment of American credits. The issue has been taken over by a banking syndicate at the price of 120 per cent. and is being offered to existing shareholders at 128 per cent. The difference between the two prices is so considerable, that it is necessary to mention that the profits realised by the syndicate will only amount to 2 per cent., whilst the balance of 6 per cent., or £30,000, is represented by legislative burdens, the stamp tax alone accounting for 3 per cent. It appears that the expectation entertained that a Belgian company which is associated with the Transmarine Co. would take over the Tranvia Metropolitano at Buenos Ayres has not been fulfilled.

The liquidation of the Union Elektrizitäts Gesellschaft, whose undertaking was taken over by the Berlin A.E.G. several years ago, has not yet been brought to a conclusion. According to the balance-sheet for 1908-9, the accounts show a deficit of £110,000, whilst the credit with the A.E.G. amounts to £13,700, as compared with £33,700 in 1907-8 on the remaining share capital of £124,000, as against £144,000 in the preceding year. As the Union Co.'s share capital stands in the books of the A.E.G. at one shilling, it appears that the latter derived a profit of £20,000 from the former in 1908-9.

The penultimate stage has now been reached in connection with the German holding of shares in the Compagnie Parisienne de l'Air Comprimé. As was reported several months ago, various French banks arranged a deal, either on their own behalf or on that of the Paris company in question, with the Teutonic possessors of ordinary shares in the company in the sense that the shares were sold to the French institutions concerned. There still remained, however, several thousand founder shares in German ownership, and these will now be transferred to the company direct by purchase. The shareholders have sanctioned the re-purchase, and the company has already assured itself of 5,400 of the founder shares, leaving very few yet to be acquired. It is proposed to cancel the shares, and the interest of Teutonic investors in an undertaking which was formerly termed a German enterprise will finally cease when the transfer has actually taken place.

The shares of the Cairo Electric Railways and Heliopolis Oases Co., which is an Egyptian company formed in 1906 under the auspices of Baron Empain, the well-known Belgian financier, have been introduced on the Paris "coulisse," or unofficial part of the Stock Exchange. The company was constituted to establish a new town at Heliopolis and construct tramways and an electric railway five miles long from the centre of Cairo to the new district. The tramways are connected with the Cairo tramways, which were also promoted by Baron Empain, and the former have been in operation since May, 1908, whilst the electric railway is on the point of inauguration. The capital of the undertaking comprises £1,200,000 divided into 120,000 ordinary £10 shares, together with 60,000 dividend shares which receive one-half of the profits remaining after the ordinary capital has been paid a dividend of 10s. per share.

A further instance of Belgian enterprise is recorded by the action of the Compagnie Générale Auxiliaire d'Entreprises Electriques, of Brussels, which has indirectly acquired a fresh block of shares in the St. Petersburg Electrical Installation Co. at the price of 109 per cent. The latter is a supply company, which was one of the Helios Co.'s creations, and it has an ordinary share capital of £1,160,000. Two-thirds of the capital in the St. Petersburg Co. were acquired by the Belgian Co. in question about a year ago, and the fresh appropriation of shares represents £386,700. These were held by the Berlin Electric Light and Power Investment Co., which originally obtained them at a heavy discount and which is understood to have disposed of them at a profit of over £200,000.

The Società Italiana di Elettrochimica, of Rome, in which the Société Franco-Suisse, of Geneva, is interested, has resolved upon the raising of £136,000 in the form of 4½ per cent. bonds for the strengthening of the company's working capital. A new hydro-electric station is being constructed by the company, which is to yield 24,000 H.P., and the provision of four generating sets of 8,000 H.P., including transformers for attaining a pressure of 80,000 volts will considerably increase the capacity of the works. It is intended to have the new station in operation by the middle of next year.

The Compagnie Héllénique d'Electricité, Système Thomson-Houston, has decided to increase its ordinary share capital from £400,000 to £600,000, by the issue of 50,000 new £4 shares. Out of this number, 33,500 shares are to serve for the payment for 25,775 shares in the Compagnie de Chemin de Fer Attique, by the exercise of an option granted by the Greek Laurium Co., whilst the remainder has been taken over by a financial group, and the proceeds are intended for the conversion of the Attique Railway to electric traction. The Compagnie Héllénique has also resolved to issue 10,000 4 per cent. obligations, redeemable in 50 years, for the purpose of disposing of the floating debt of £160,000 owing to the French Thomson-Houston Co., and these are to be placed on an equality with the existing bonds of £390,000 already in circulation.

The Société de Tramway de Constantinople, whose lines are proposed to be converted to electric traction by electrical firms which are associated with French, German and Swiss financial institutions, has convened an extraordinary meeting to consider resolutions for calling up further capital for the purpose of defraying expenditure necessary in order to comply with certain terms of the company's concession that can be no longer delayed. At present the nominal capital in Turkish pounds amount to £657,200. Apart from shares which have been redeemed there are now in circulation 17,934 old £17 shares and 17,617 new £20 shares, upon both of which the sum of £5 has been paid. It is now proposed to make a call of £2 10s. per share on both classes, and the directors also seek authority to requisition a further £5 per share in case of necessity, the two calls providing fresh funds to the amount of over £266,000.

THE NATIONAL PHYSICAL LABORATORY.

THE report for the year 1909 was issued on the occasion of the meeting of the general board on March 18th, when also an inspection of the laboratory took place. The report of the executive committee summarises the Order in Council dealing with the electrical standards of the Board of Trade (ELECTRICAL REVIEW, Jan. 14th, 1910), and remarking that the Order contained no reference to a standard cell, states that the Weston normal cell, set up in accordance with the specification of the International Conference on Electric Units, will be used for convenience in standardisation, its value being taken provisionally at 1·0184 international volts at 20° C. The Lorens apparatus for the determination of the ohm has arrived at the Laboratory. During the year 155 electrical measurements were carried out in the Physics Department, the same number as in 1908; and 2,328 in electrotechnics, compared with 1,760 in 1908, there being marked increases in connection with supply meters, primary cells, and fuses. In photometry there were 913 tests, compared with 779—mainly incandescence electric lamps. Good progress has been made with the experimental tank for ship models and the aeronautical department.

The accounts show that the income of the Laboratory has increased from £21,871 to £24,270, the difference including a grant of £1 923 for aeronautical work. The fees for work done rose from £13,089 to £14,241. The expenditure amounted to £24,087, leaving a balance of £184 for the year, but against this there was an excess of expenditure over income at the Eskdalemuir Magnetic Observatory of £116. It is suggested that the time has come for the separation of the meteorological work taken over from the Kew

Observatory from the work of the National Physical Laboratory, and a scheme is under consideration with that end in view. It is proposed also to carry out large extensions of the Laboratory by instalments, at a total cost of £30,000.

The work in view for the current year includes further research in connection with the electrical standards, high oscillation frequencies, telephone cables, and iron testing. The construction of a graduated series of metallic-filament lamp standards at efficiencies from 4·5 to 1·1 watts per candle will be continued; new A.C. test stations will be installed, and the investigation on electrical insulating materials for the Engineering Standards Committee will proceed.

An International Conference between representatives of France, Germany, Great Britain and the United States, will be held at Washington this month to decide on a definite value for the Weston standard cell; Mr. F. E. Smith will be the British representative.

The director's report states, in connection with the fundamental units (Mr. F. E. Smith), that the Lorenz apparatus is practically complete. New mercury standards are being constructed, and experiments with wire coils have been carried out, showing that their resistance remains much more constant when they are hermetically sealed, to exclude atmospheric moisture, which materially affects shellacked coils. A research on cadmium amalgams for the Weston cell revealed the fact that if more than 11 or 12 per cent. of cadmium were present, the past thermal history of the cell appreciably affected its E.M.F. A 10 per cent. amalgam always behaves normally, and as the standard cell has at present a 12½ per cent. amalgam, the advisability of substituting for this a 10 per cent. amalgam will need consideration by the International Committee. Of 67 Weston cells tested during the year, 60 did not differ in E.M.F. by more than 1 part in 10,000 from the N.P.L. standards.

The Ayrton-Jones current balance has been overhauled and reset, with increased sensitiveness, and has been used with satisfactory results.

Under the heading of General Measurements (Mr. A. Campbell), the report states that a large mutual inductometer has been completed, giving ranges from 0·01 to 1,000 microhenries, and 0·1 to 10,000 microhenries, and forming a very accurate sub-standard for the measurement of inductance. The measurement of the effective resistance of telephone loading coils, and other highly inductive coils has been carefully investigated, and a paper on the subject is ready for publication. Magnetic tests have also received much attention, and a method of testing iron strips has been devised which gives good results; it has been found that the effect of shearing soft sheet steel extends for a considerable distance into the strip, rings of 2·5 cm. radial width sometimes showing a total loss 8 to 10 per cent. higher than in strips 7 cm. wide.

In the Department of Electrotechnics (Mr. C. C. Paterson) an investigation on the dielectric strength and the rigidity of ebonite has been completed, non-inductive resistances for heavy alternating currents have been constructed, and the use of the unventilated hygrometer in connection with flame standards of light has been examined. Progress has been made in other investigations, but has been retarded by the increased volume of test work. The international agreement as to the adoption of a common unit of light is summarised in the report. In connection with the construction of graduated sets of electric sub-standards to bridge over the gap between the colours of the light emitted by 3·5-watt and 1·1-watt lamps respectively, some difficulty has been experienced owing to the occurrence of small fluctuations in the candle-power of some of the 1·5-watt metallic-filament lamps, inappreciable in commercial work, but inadmissible in standard lamps; the cause of the defect is being investigated. Interesting results have been obtained in the course of the inter-comparisons between the different sub-standards by five observers; where an accuracy of 0·3 per cent. is aimed at, in comparing two sub-standards run at, say, 3·5 and 4·0 watts per candle, it is not safe to assume that there is no correction for the personal error of the observer, even though his sight is normal when examined by the ordinary colour tests, and the difference in colours is very small; but the personal error of an observer for a small colour difference is constant. In fixing the relative values to 0·2 per cent. of two slightly differing sets of sub-standards, as many observers as possible should be employed, in order to secure a representative mean. Comparisons over a wider colour interval are in progress, and will afford interesting results when considered together with the intermediate stages. Let us assume that a series of lamps of graduated efficiencies has been completed, all, say, of precisely the same candle-power when consecutive pairs are compared; if then the extremes are compared as accurately as is practicable, having in view the wide difference between their colours, they may be found to be sensibly equal in candle-power, and this will be a very satisfactory result. But it is quite likely that there will be an appreciable difference between them when thus compared directly, and the question will arise—where does the error come in?

A specially-designed quadrant electrometer has been set up for use as an A.C. wattmeter, and the standard water-cooled non-inductive tube resistances have been found a valuable addition to the resources of the laboratory. The largest tube is capable of dissipating about 6 KW., giving a drop of 2·5 volts with 2,500 amperes. The research on ebonite showed that the dielectric strength of adulterated samples ranged from 60,000 to 90,000 volts per millimetre, and that of purer samples from 100,000 to 150,000 volts/mm. Ebonite made from Para rubber gave the highest strength. The research on insulating materials for the Engineering Standards Committee, carried on by Mr. E. H. Rayner, led to the conclusion that most valuable results could be obtained by accurately measuring the loss of energy in the materials under test, and an electrostatic wattmeter has been devised for this purpose, working at 10,000 volts and upwards. Experiments on varnished cloth show a great increase, with rise of temperature, in the loss of electrical energy in the insulating material, and the consequent heating of the latter. The watt loss, therefore, rises at an increasing rate with time, and becomes extremely rapid just before breakdown takes place. The high-voltage equipment for the purpose of these tests has been completed, and includes a 20-KW. motor-alternator, supplying current to a 20-KW. transformer, giving 100,000 volts; these were made by the British Westinghouse Co., Ltd., at the expense of the Engineering Standards Committee. The voltmeter equipment provides for the accurate measurement of any pressure from 200 to 100,000 volts; it consists of a Hartmann and Braun precision voltmeter reading to 500 volts and taking a current of 0·02 ampere, with additional resistances to carry 99,500 volts, in 18 separate boxes, which are carried on large porcelain insulators. The wave-form of the high-pressure supply was determined during the testing of a Duddell oscillograph for 50,000 volts, made by the Cambridge Scientific Instrument Co. The voltmeter circuit takes 2 KW. at 100,000 volts, and conveniently provides a steadying load, tending to modify sudden voltage rises such as are common with high-pressure apparatus.

The test work (under Mr. S. W. Melsom) has included the testing of a number of watt-hour meters of large size for use on variable loads, which was accomplished by varying the load from one-quarter to full load in periods of 30 seconds to 2 minutes; the current (up to 500 amperes) was recorded on a fast-moving chart, on which the seconds were also marked automatically by a pen controlled by the standard clock. A large accumulator by the D.P. Battery Co., one of a battery for the East India Railway Co., was subjected to a complete series of tests, lasting over a period of three weeks; the 1-hour rate of discharge was about 950 amperes. The insulation resistance of a cable was tested at temperatures ranging from 0° to 100° C., and was found to decrease enormously as the temperature increased. A large number of primary cells was tested, and a special series of tests was commenced on cells supplied by four makers under eight different conditions of discharge. This investigation is still in progress. Experiments were also carried out on the heating of cables, for the Wiring Committee of the Institution of Electrical Engineers, and various other tests are in progress.

In Thermometry, Dr. Harker has continued the improvement of the equipment, especially in the new furnace room. A Crompton motor-alternator, giving 15 K.V.A., has been installed to supply the induction furnace and for general use, and a new apparatus for the comparison of thermocouples has been completed. Apparatus and methods for testing pyrometers have been organised, and an induction furnace, presented by the English Gröndal Kjellin Co., has been installed.

In the engineering department further experiments have been made on the heat transmission of air currents in pipes, the tensile strength and elasticity of long wires at varying temperatures, and many other interesting subjects.

LEGAL.

AUTOCLAW CO., LTD., *v.* JACKSON & CO.

BEFORE Mr. Justice Ridley in the King's Bench Division on March 22nd, Mr. Jas. Todd, as Receiver and manager of the Autoclaw Co., Ltd., brought an action against Messrs. H. A. Jackson & Co., manufacturing electrical engineers, of the Caxton Works, Salford, for £106 15s. 6d., money alleged to be due as the balance of the purchase price of a quantity of electric light switches and other fittings.

The defence was that the switches were not according to order, and that plaintiff had notice of rejection. Defendants counter-claimed for damages for the non-delivery of the goods they said they had ordered.

MR. J. A. COMPSTON, for the plaintiff, stated that on May 14th, 1909, defendants entered into a verbal agreement with the plaintiff to buy 150 gross of No. 65 imitation Tucker switches at 57s. per gross, less 5 per cent. discount for cash. On September 28th some of these were delivered, and a cheque was sent to the plaintiff, accompanied, however, by an intimation that in case the goods should prove to be not according to order, defendants reserved their rights; later, defendants had reason to be dissatisfied with the goods, and they wrote alleging that they were not according to order. It was complained that whereas the goods ordered had a base of English porcelain, those supplied had bases of German porcelain. Another complaint was that the switches were not made with English brass contact plates, and that the rollers were of bone or composition rather than brass, as ordered. But really the switches were very good imitations of the Tucker switches, and were such as the Autoclaw Co. had been making for six months previously.

MR. G. MARKT, giving evidence on behalf of the plaintiff, said that defendants agreed to buy this lot of switches at a time when the market price for them was 66s. These were sold at 57s. because they were a job lot. The defendants made no stipulations when giving the order as to the kind of roller the switches were to have, and witness contended that the bone roller was better than a brass one as it afforded a double insulation. He admitted that German porcelain was not as good as English.

Other witnesses also gave evidence for the plaintiff.

Mr. Hogg, for the defendants, submitted that the only question to be decided was whether these articles were No. 65 imitation Tucker switches. The switches which defendants had formerly got as such were materially different. The effect of having a German porcelain base was that instead of the base having an absorptive power of .3 per cent., there was a capacity for moisture absorption of 10 per cent., and the danger of a leakage of current was very much greater than in the article which defendants agreed to buy.

Mr. H. A. Jackson, proprietor of the defendant firm, said he ordered the No. 65 imitation Tucker switch. A delivery of 20 gross was made, but his people were so busy at the time that they had not time to examine them. He did not find out about the switches supplied until later, when he sold five gross to a customer, who refused to have them. On this he wrote, saying that he proposed to return them to the plaintiff.

Cross-examined, Witness said that the bone rollers sometimes contracted, and if there was damp about the walls they swelled.

Mr. H. Barlow, Mr. A. Rowell Young (of the defendant company) and Mr. Percy Huddleston gave evidence that the bone roller was susceptible to damp, and Mr. G. T. Baker (London manager of J. H. Tucker & Co.) said his firm made switches with brass rollers only.

His Lordship gave judgment for the plaintiff on the claim and counterclaim. In doing so he said defendants had to make out that the goods delivered were substantially different from the goods agreed to be delivered. If the defendant did not want the composition roller it lay with him to make that stipulation beforehand. He was not satisfied that the objection to the German porcelain was substantial. Judgment would be for the plaintiff for £100 1s. 3d. and costs.

Luscombe *v.* Fryer.—Leave to Appeal.

In the Chancery Division on Wednesday, March 23rd, Mr. Justice Parker heard an *ex parte* application by the plaintiff in this action for liberty to appeal from a decision of Mr. Muir Mackenzie, one of the Official Referees.

Mr. F. Watt, who made the application, said that the case was assigned to his Lordship by an order made on July 28th, and was set down for trial before an Official Referee. It was before Mr. Muir Mackenzie for three days, March 4th, 5th and 7th, and judgment was given the following Friday dismissing the action with costs. The action was brought for wrongful dismissal, the plaintiff having been engaged by the defendant as an electrical and mechanical engineer at a salary of £100 a year and commission. The plaintiff's funds had all been exhausted, and he now wanted to bring his appeal in *forma pauperis*.

His Lordship pointed out that what was asked by the application was in effect to deprive the defendant in the action of his right to security for costs.

Mr. Watt said it was of great importance to the young man that it should be held that he was not dismissed from his employment for negligence. The Referee had given a written judgment because he thought that there would be an appeal.

His Lordship said that he was adverse to making the order without going more fully into the merits of the case, but it seemed to be the practice to make these applications *ex parte*, and he would not depart from the rule. He accordingly gave the required leave.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

B.T.-H. "Mazda" Incandescent Lamps.

The peculiarities of the tungsten-filament lamp are, no doubt well known to our readers—the low tensile strength of the filaments and their extreme brittleness, due mainly to the inability of the manufacturers to draw the metal in the form of wire, and the consequent necessity of resorting to various indirect methods of producing the equivalent of wire. Chief amongst the latter are the use of an organic binding material to hold the particles of tungsten in place while the filament is made, the binding material being afterwards eliminated; the use of tungsten in a plastic colloidal form; and the B.T.-H. process, in which the tungsten is held together by a ductile alloy which can be drawn or pressed into the form of a filament, the metal binder being afterwards removed. With the aid of these methods, remarkably successful results have been attained, in spite of the rather unpromising nature of the processes; but, although the tungsten lamp has attained so high a standard, its sensitiveness to shock still constitutes a serious drawback to its use.

Recognising this fact, the General Electric Co., of America, has for several years been engaged upon a research with a view to developing a process of manufacture which would enable tungsten to be drawn into filaments, and we are pleased to learn from the British Thomson-Houston Co., Ltd., who are the owners of the patent rights in Great Britain, that a successful result has now been attained. The B.T.-H. Co. will shortly place on the market lamps containing pure drawn tungsten filaments, which, we are informed, are as strong as steel of the same section, and can be tied in knots without fracture. This is an achievement which has hitherto been considered beyond the bounds of possibility. The metal can now be drawn into the finest filaments required for incandescent lamps.

Until the process of manufacture is fully established, the new "Mazda" filaments, as they are called, will be supplied in only one or two types of lamp, but no time will be lost in extending their application. The makers are to be congratulated on the solution of one of the toughest problems ever met with in the manufacture of incandescent lamps.

The Lux Adaptation Candle.

We recently described (Electrical Review, January 28th, 1910) the "Lux" patent electric candle lamp in which the lamp can be renewed apart from the candle; the Lux Candle Co., Ltd., of 240, High Holborn, W.C., have now brought out a new patent "adaptation" candle, which enables the user to adapt any existing candle fitting to the Lux system, without renewal of any part of the fitting. As will be seen in the accompanying illustrations, figs. 1 and 2, the

Fig 1.

Fig. 2.

Lux Patent Adaptation Candle.

usual bulb flame lamp is replaced by a short Lux lamp, and the Lux candle is passed over the whole candle fitting. The lamps are made with either carbon or metal filaments, as desired, and the candle can be cleaned without disturbing the lamp, so that its life is not endangered.

New "Tantalum Focusing" Lamp.

It is well known that the end-on candle-power of metallic-filament lamps is decidedly weak, although a good horizontal candle-power is always maintained. Messrs Siemens Bros., Tyssen Street,

Fig. 3.—Tantalum Focusing Lamp.

Dalston, N.E., who are the makers of the tantalum metal-filament lamps, are now placing upon the market a new type of lamp which will be known as the "Tantalum Focusing" lamp, having an entirely new arrangement of filament by which a maximum end-

on candle-power is obtained. The spider on which the filament is wound is constructed in a conical shape, the apex of the cone pointing downwards. The special feature of this lamp is that it distributes the light very evenly, except towards the cap of the lamp, where the light is not required. The illumination curve in a vertical plane will presumably somewhat resemble the figure 8. These lamps are now being supplied for 100 to 130-volt circuits in the 25 c.p. size, in spherical bulbs measuring approximately 75 mm. in diameter. They are especially suited for places where it is desired to obtain a strong and even light without the aid of special reflectors, and should prove useful for stage lighting, ceiling lighting and decorative purposes. They are of the same efficiency and durability as the ordinary standard type of tantalum lamp.

PARLIAMENTARY.

Scottish Provisional Order Procedure.—Mr. George Younger asked the Lord Advocate whether the attention of the Secretary for Scotland had been called to the fact that in the case of nine of the 18 Provisional Orders deposited at the Scottish Office last December, the parties promoting and opposing those orders lodged representations, and attended before the Lord Chairman of Committees and the Chairman of Ways and Means to request that these orders might proceed as Private Bills, and not as Scottish orders; and whether, in view of the persistent efforts made by promoters and opponents of Scottish Provisional Orders to have them proceeded with as Private Bills, he would reconsider his decision as to the need for early legislation to remedy the alleged defects in the Act which led to this course of action. Mr. Ure, in reply, admitted the fact as to the requests made, but could not agree with the inferences drawn, and the answer to the question was, therefore, in the negative. Mr. Watt asked if the hon. gentleman was aware that town clerks are advising their councils that it would be better to proceed by Private Bill than by Provisional Order. Mr. Ure replied that he was not aware of it.

Morecambe Tramways Bill.—On Tuesday last week the Unopposed Bills Committee of the House of Lords passed the preamble of this Bill. The measure provides for the reconstruction and alteration of the tramways, and gives the promoters power to use mechanical power. The company have sold their undertaking to the Corporation, and the Bill provides for voluntary winding up.

THE PREMIUM BONUS SYSTEM.

It would appear that the premium bonus system which many employers have adopted, to their own advantage and to the satisfaction of those of their workmen who are able to take advantage of it, is about to incur the censure of the Trade Unions. A committee, of which Mr. Shackleton, M.P., was a member, was chosen last summer to consider and report on the matter. They toured the country and took the evidence of 61 witnesses, and have now issued their report. They find that the system is detrimental to organisation and to Trade Unionism; that it increases the cost of production; and that it tends to make men scamp their work. They also (with one exception) find that it tends to increase unemployment. The "exception" is the secretary of the Amalgamated Society of Engineers, who thinks that unemployment is due to labour-saving machinery. But the committee are constrained to point out that no employer who has adopted this system has ever voluntarily abandoned it.

The report is to be dealt with at the next Trade Union Congress. To our mind, the fact that the premium bonus system is opposed to Trade Unionism is about as good testimony in its favour as one could possibly have. That it has escaped the attention of the Unions for so long is a strange commentary upon the vigilance of these bodies. The truth is, of course, that employers as a whole, and the more capable and industrious among the working classes, are always endeavouring to shake off the Union fetters. The employer wants to get as much as he can for his money; the energetic artisan, who wants to get on, and who knows he can work better and more rapidly than the majority of his fellows, is anxious to take advantage of any system whereby the hopeless restrictions imposed by the Unions can be circumvented. "I took the chances they wouldn't, and now they're calling it luck," is the short history of success in every walk of life. The fact that this system has grown up, and has been largely adopted by employers—particularly those employers whose business involves the manufacture of thousands of machines of the same type—bears witness to the limitation which political economy puts on the power of Trade Unions. It fully justifies the opinion of Mr. Cairnes when he wrote in his "Leading Principles of Political Economy" (1874):—"My conclusion is that, though combination, whether employed by capitalists or by labourers, may succeed in controlling for a time the price of labour, it is utterly powerless, in the hands of either, to effect a permanent alteration in the market rate of wages as determined by supply and demand."

Nothing has done more to encourage employers to adopt labour-saving machinery than the ridiculous system of trying to make work for inefficient men. Similarly, if the employer finds himself compelled by Trade Union rules to pay certain rates of wages, he will move heaven and earth to find some plan by which the better workman shall be encouraged.

STACKS FOR WATER-TUBE BOILERS.

There is a tendency for some writers to boil everything down to a formula. This is done by Mr. T. F. I. Maguire in an article on the above in the *Engineering Magazine*. He discusses the question of draught generally, and points out that the intensity of draught must increase as the proportion of fixed carbon in the coal increases, anthracite requiring most draught, and the fullest bituminous coal the least. Different draughts and different effects in the furnace are closely connected with such items as percentage of ash, the tendency to form clinker, and generally to furnace forms and so on. The chief resistance to the flow of air through a furnace is the fuel bed itself. Witness, for example, the very small chimney that is required for liquid fuel. Air is easily pulled through unobstructed flues, if we may so use the word to express a draught effect. The author, in referring to the loss of draught in the boiler setting, makes a curious remark. He says the principal loss is in the middle pass where the hot gases travel downwards when the "natural tendency of hot gas is to rise." This is a curious statement to make concerning hot gases in a boiler setting full of them. The natural tendency of every gas, hot or cold, light or heavy, is to fall under the effect of gravity. To speak of the opposite tendency shows a confusion of thought which arises from the neglect to measure things generally from their absolute zero of temperature, position or pressure. The middle pass, on the contrary, has the best draught tendency if slight gravity effect is worth taking into account.

The intensity of draught at the breeching entry to the stack is given as $D = 0{\cdot}42\ H.P.\left(\frac{1}{T} - \frac{1}{T_1}\right)$, where D = inches of water column; H = height in feet of top of stack above grate; P = barometric pressure in pounds per sq. in., and T and T_1 the absolute temperature of the outside air and the inside gases of the stack.

At sea level P = 14·7; average conditions give the atmospheric temperature as 70° F. This may be right for America, but it is too high for this country. However, substituting these values, $D = 0{\cdot}0055\ H$, or $H = \frac{D}{0{\cdot}0055}$, a formula practically correct for most cases. For high altitudes the stack height should be increased in the inverse ratio of the barometer height there and at sea level.

The stack diameter in inches is $d = 2{\cdot}12\ (C_h)^{\frac{1}{2}}$, where C_h = pounds of the poorest coal likely to be used and at maximum load. The assumption is that 18 lb. of gas will be made per pound of coal, and the gas temperature is 550° F. For altitudes the diameter is to be increased by multiplying by the $\frac{2}{3}$th power of the ratio of the barometer at sea level to the barometer at altitude. Such papers are useful as guides, and may be kept for reference. Diameters as found above are increased $\frac{1}{10}$th for brick-lined stacks. Every case must, however, receive its own treatment, in spite of formulæ.

BUSINESS NOTES.

Electric Lighting of a Skating Rink.—It is nowadays necessary for electrical contractors to be exceedingly smart in getting after business if they mean to stand against the fierce competition which is a feature of the present state of the industry. It is, however, satisfactory to note that they are by no means unable to cope with the situation thus created. A case in point occurs in connection with a change-over from high-pressure incandescent gas lighting at the White City, Newcastle-on-Tyne, to a system of electric lighting by means of metallic-filament lamps. The proprietors of the White City after reaching the decision to change over, sent their order to Messrs. Robson & Coleman, of Haymarket Lane, Newcastle, and it was received by them at 8 a.m. on Wednesday, March 2nd. Within 30 minutes the employés of the firm were actually at work on the premises. The installation is a permanent one of about 400 lights, and it was finished by 5 p.m. on Monday, the 10th ult.—that is to say, within a period of eight days. The main floor is lighted by means of six large diamonds, each carrying 32 lights. The diamond structures, which are about 40 ft. across diagonally, were assembled complete in Messrs. Robson & Coleman's own works and then put into place at the building with the minimum of obstruction to the roller skaters. The diamonds are so arranged that they can be switched on diagonally for lighting effects. Each light consists of a 16-c.p. metal-filament lamp and is shaded by an artistic beaded fringe shade. The wiring of the installation sub-circuits is carried out on the surface system, with insulators.

British Westinghouse Engineers' Club Dinner.—The fourth annual dinner of this club was held at the Grand Hotel, Manchester, on Friday, March 18th, and was attended by about 200 members of the staff, mostly members of the club. Mr. J. S Peck, chairman of the club, presided. Mr. Newcomb Carlton, managing director of the company, on his arrival from London, received a great ovation.

Mr. D. N. Dunlop, sales manager of the supply department, proposed the toast of "The Company," coupled with the name of Mr. Carlton. Mr Dunlop, in the course of his remarks, referred to the excellent spirit of co-operation which now permeated the whole organisation. He voiced the sentiment of all present in expressing the hope that Mr. Carlton would long continue to direct the affairs of the company in the able manner which had characterised his work, and which had produced such a marked improvement in its position during the years of his administration. Mr. Carlton, in responding to the toast, referred at some length to growing competition between the great manufacturing nations of the world, and spoke of the necessity of Great Britain bringing up its efficiency in technical matters to the same high pitch as it has attained in commercial ability. He also referred to the limitations placed by Trade Unions on productive output, and while recognising the benefits that British working men derive from Trade Unions, hoped that they would soon realise the necessity of removing such restrictions from production, and enable Great Britain to maintain her position in the markets of the world. It was in the interests of employers and employés alike that both should work together to this end. In concluding his speech, Mr. Carlton alluded to the great progress made during the past few years in the company's business, and referred to its future prospects in a way that inspired everyone with confidence in even greater success being attained.

Mr. Blunt, general sales manager, proposed the toast of "The Works Organisation," coupled with the name of Mr. Lange, managing director of works. Mr. Blunt stated that during a year of considerable trade depression the company had maintained and improved its position, and that the business done during the two months of the current year showed considerable improvement over the same period of the previous year. He said that this spoke well for the company's sales organisation, and congratulated the various sales engineers and district office managers on the excellent results obtained by their efforts. He also expressed his appreciation of the way in which the selling and manufacturing departments were working together. Mr. Lange, managing director of works, responded to the toast. Mr. Lange began his speech by expressing his thanks to Mr. Carlton for the allusion he had made to the labour conditions, which made it unnecessary for him to deal with that subject as he had done on previous occasions. He could therefore, he said, restrict his speech more particularly to the actual conditions affecting the works organisation, and the relations of the works organisation to the sales organisation. While expressing in general his agreement with what Mr. Blunt had said with regard to the benefits of co-operation between the various sections of the organisation, he stated that, in his opinion, improvements in many directions were still necessary, and gave various illustrations showing the necessity for greater co-operation between the various departments of the works, so that each works department would utilise to the utmost the experience of all other departments. He mentioned the difficulties in a large organisation in accomplishing the best results without such co-operation, because the customers of the company looked upon it as a unit, and did not take into consideration the departmental system in their dealings with the company. Mr. Lange, in concluding, thanked the various superintendents and foremen for the way in which they had responded to his suggestions in the past, and said he had no doubt but that he could look forward with equanimity to the continuance of their support in the direction indicated in the early part of his speech.

Mr. Tearle, deputy general accountant, proposed the toast of "The Engineers' Club and the Foremen's Association." The toast was responded to by Mr. Peck, on behalf of the Engineers' Club, and by Mr. Currie, on behalf of the Foremen's Association. Mr. Peck hoped that the company's apprentices would take greater advantage of the opportunities afforded by the club for their benefit in an educational as well as a social direction. Mr. Currie expressed the hope that the engineers would be able more frequently to attend the meetings of the Foremen's Association, and so give them the benefit of their advice and experience in discussing the problems which came before them.

During the evening several members of the staff contributed to the musical programme. Mr. T. M. Kirkby sang a topical song, allusions in which to the weaknesses of various members of the staff were received with much appreciation.

Catalogues and Lists.—Messrs. James Baldwin and Co., Devonshire Brass Works, Keighley.—New pamphlet containing effective illustrations, particulars and prices of their "Overall" equa-expansive jacketed cock for blow off and other purposes.

Messrs. W. H. Keys, Ltd., 101, Leadenhall Street, London, E.C.—Pocket pamphlet drawing attention to their new "Mastico" bituminous cable solution, which has been specially prepared for cable-makers and electrical engineers.

Messrs. Grey & Marten, Ltd., City Lead Works, Southwark Bridge, London, S.E.—An excellent and well-bound catalogue of 376 pages containing illustrations and prices of a great variety of manufactures used by builders, contractors and others interested in the erection and fitting out of private houses, public buildings, and so forth. There is a section relating to electrical fittings and sundries for bell and lighting work. Architects and contractors should find the catalogue very serviceable.

Mr. A. Campbell Adams, 52, St. Enoch Square, Glasgow.—Price leaflet briefly describing his method of automatically governing electrically-driven air compressors.

Messrs. W. Geipel & Co., Vulcan Works, St. Thomas Street, S.E.—Leaflet giving particulars, prices and tests of their "Firmacit" cables.

Messrs. Bruce Peebles & Co., Ltd., Edinburgh.—Pamphlet No. 19A, in the company's standard size and style, containing in the course of 20 pages full specifications of open and enclosed types of turbo-alternators, also various illustrations of the complete machines, as well as the stators and rotors which are shown separately. Tables of outputs of the various frame sizes at speeds of 1,500 and 3,000 r.p.m., for 50-25 cycle circuits, are given, also tabulated particulars of weights and dimensions.

The Lux Candle Co., Ltd., 240, High Holborn, W.C.—Catalogue describing the Lux candle and the Lux adaptation candle, with prices.

Trade Announcements.—Premises at 25, Packer's Row, Chesterfield, have been opened by Mr. Edgar R. Morris, electrical engineer, of Brampton.

The Underfeed Stoker Co. have appointed Mr. A. A. Tasker, of 110, Queen Street, Cardiff, as their sole representative for South Wales, in place of Messrs. Haslam & Schontheil, who have relinquished the sole agency. Messrs. Haslam & Schontheil are not, however, giving up all connection with the Underfeed Stoker Co., and any inquiries for mechanical stokers, forced-draught plants and air heaters, addressed to them will receive attention.

Messrs. Feld Bros. & Co., Ltd., of 25, Budge Row, E.C., have taken over the sole agency for Great Britain of Messrs. Rosenthal and Co., Bavaria, for their high-tension insulators.

Messrs. Clarke, Chapman & Co., Ltd, have opened an office at 29, Queen Anne's Chambers, Westminster, S.W., for the sale of their Clarke-Chapman water-tube boilers (Woodeson's patent).

Messrs. Speedy, Eynon & Co., electrical engineers and contractors, have removed their offices and stores to 6, Duke Street, Adelphi, Charing Cross, W.C.

Messrs. Orchard & Co., electricians, of Weymouth, have opened new premises in Maiden Street.

Messrs. L. Andrew & Co. have removed to their new warehouse at 2, Whitworth Street West, Deansgate, Manchester.

Dioptric Illuminated Signs.—The sole rights in connection with this device (which was described and illustrated in our issue of October 22nd, 1909, page 650) have been acquired by the Davis Electrical Co., Ltd., 17, Moor Street, Cambridge Circus, W., to whom all inquiries should be addressed.

Mr. H R. Wade, electrical engineer, 18, Acre Street, Denton, invites firms to send him catalogues of everything electrical.

Petrol Motor Tower Wagons.—The Tramways Committee of the Manchester Corporation is inviting tenders for the supply of a petrol motor tower wagon for use in connection with the maintenance of the overhead conductors of the electric tramway system. The Town Council of Southport has just placed a contract with the Leyland Motor Co. for a similar vehicle.

Watch this Spot!—An American Consul in this country has written home to the States giving the names of seven towns in his district which have an electric car system, together with the total authorised mileage, mileage under operation, and the money invested. He states that much of the equipment of these lines was purchased in the United States, and as the companies are from time to time extending their service, making repairs and renewals, and linking up existing tracks, it is suggested that American firms follow these developments and endeavour to secure further orders in that district.

Book Notices.—*Electrical Control of Printing Machinery.* By Adams Manufacturing Co., Ltd. Bedford: From the Company. Price 1s.—This, we understand, is regarded by the company as the most complete treatise on the subject that has ever been published, and embodies the information that it has gained from its wide experience in this branch of engineering. In a sense this may be true, though the bulk of the work is devoted to a description of the devices which have been evolved by the company for the purpose named in the title. The advantages of electrical control are admirably set forth, and the features peculiar to the operation of printing machinery are lucidly explained; great importance is attached to inching, which is dignified by the use of quotation marks (and generally a capital I) wherever it is mentioned—surely a superfluous distinction. The undoubted fact that suitable controlling apparatus is the main essential to success in this important application of electric power is thoroughly driven home, and the many onerous conditions that must be fulfilled by the perfect controller are detailed. The methods adopted by the company in meeting these requirements are then described in order. The only successful method of inching without injury to the switchgear is stated to be that of breaking circuit *always* with a special circuit-breaker, preferably interlocked with the starting switch and magnetically operated. The push-button system is regarded as the very best, securing both simplicity and safety to the operator—a most important quality; a hand-operated starter, however, is also described, with an ingenious device which ensures the opening of the circuit by the circuit-breaker whenever the starting switch is given the slightest backward movement. Speed regulation, shunt and series, reversing, stopping, overload preventers, interlocking devices, and complete push-button control for rotary presses, are other subjects dealt with, and numerous illustrations of the company's apparatus are given. It is a useful and interesting work, but would be greatly improved by diagrams of connections, of which not one is given. In the preface it is stated that when electricity is used there is practically no loss in transmitting the power to different parts of the works, and the loss incurred in driving shafting, pulleys and belts—50 to 70 per cent.—is eliminated, as well as the initial cost of these, and the cost of repairs and renewals. No countervailing losses or expenses are mentioned, and though undoubtedly these are greatly reduced, the omission to refer to them is regrettable, being likely to shake the confidence of the wily printer, who is no fool.

The Aeroplane Portfolio. By D. R. Kennedy. London: Percival Marshall & Co. Price 1s net.—Those of our readers who are interested in aeroplanes—and what engineer is not?—and wish to become more closely acquainted with them will find this excellent collection of nine scale drawings of the most famous biplanes and monoplanes far better than any verbal description of their build. Particulars of the achievements, mode of operation, &c., of each type are given in a small accompanying booklet, together with shrewd comments on their peculiarities.

The Marine Oil Engine Handbook.—Compiled by the staff of *The Motor Boat.* London: Temple Press. 1910. Price 1s. net.—This is a treatise which has grown out of a chapter of *The Motor Boat Manual*, and deals not with pleasure types but with engines used for trading purposes, as in fishing boats, canal barges, &c. It is, therefore, couched in simple language, and describes some of the most generally used engines, explaining how they work, how to look after them and so on. A lengthy section is devoted to the various methods of electric ignition, in which is included an explanation of the nature of electricity and the terms used in connection with it, and details of coil and magneto ignition. The book will certainly prove useful to a large and growing circle of readers.

The Journal of the Municipal School of Technology, Manchester. Vol. 2.—In this volume is continued the record of the investigations undertaken by members of the teaching staff of the school; it contains about 300 pages, admirably printed and produced, and its literary contents are worthy of their setting. Most of the electrical work—which is given precedence—has been published in the form of papers read before the Institution of Electrical Engineers, including "Fuse Phenomena," by Prof. A. Schwartz and Mr. W. H. N. James; "The Electric Discharge and the Production of Nitric Acid," by Messrs. W. Cramp and B. Hoyle; and "Electrolytic Corrosion," by Prof. W. W. H. Gee; there are also two articles by Messrs. W. Cramp and C. F. Smith, on "The Alternating-Current Circle Diagram" and "Vector Algebra for Alternate Current Problems." Most of the other papers relate to the textile and chemical industries. The volume affords convincing evidence of the activity and usefulness of this modern "Manchester School," and it is an especially noteworthy and commendable feature that the very able staff is wisely afforded the time and opportunity to carry out these valuable researches.

"*Transactions* of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXVI, Parts 2 and 3. March, 1910. London: Andrew Reid & Co.

"*Transactions* of the Illuminating Engineering Society." Vol. IV, No. 9. December, 1909. Easton, Pa.: The Society. Price 50 c.

"Applied Mechanics and Mechanical Engineering." By Andrew Jamieson, M.Inst.C.E. Vols. I, II, III and IV. London: Charles Griffin & Co., Ltd. 1910. Price, Vol. I, 6s., Vols. II, III and IV, 5s. each.

"Fortschritte der Elektrotechnik." 1909. Berlin: Julius Springer. Price M.10.

Osram Lamps in a Fire.—At a fire which recently occurred on the premises of the Hertford Hardware Supply Co., Hertford, a number of Osram lamps were burning during the whole time the fire was in progress. The lamps were burning in pairs right in the midst of the danger zone, and, consequently, came in for a considerable amount of rough usage; in the efforts made by the local fire brigade to extinguish the flames, they had

Osram Lamps at a Hertford Fire.

to resort to flooding the floor and ceiling of the shop where the fire occurred, and a hosepipe was on several occasions actually playing upon the lamps. Although the surroundings were badly damaged and burnt, Mr. J. M. Bowman, resident engineer of the electricity works, reports that these Osram lamps held out during the whole of the time, and are still burning to-day as though nothing had happened. The accompanying illustration has been reproduced from a photograph taken after the fire.

Japan.—*The Indian Textile Journal* (February) states that the negotiations between the American General Electric Co. and the Shibaura Engineering Works with a view to amalgamation of interests in Japan, according to a cable received by the Mitsui Co., "have taken a favourable turn."

Bankruptcy Proceedings.—W. C. Ellis, electrician, Applegate Street, Leicester.—First meeting, April 1st; public examination, April 8th—both at Leicester.

J. W. Hunter and A. Clapham (Yorkshire Motor-Car and Electrical Engineering Co.) Leeds.—Date fixed for proceeding with public examination, April 19th, at County Court House, Albion Place, Leeds.

Wilfred Herbert Durrant, electrical engineer, Lowestoft.—A receiving order was made on March 21st, on debtor's own petition. First meeting, April 6th, at Norwich; public examination, May 3rd, at Yarmouth.

Walter Sydney Jenkinson, electrical engineer, Rodborough, near Stroud, Gloucestershire.—Mr. Registrar Hartland held a sitting at the Shire Hall, Gloucester, last week for the public examination of the above debtor. The statement of affairs showed liabilities to rank at £90, and the deficiency £68. The debtor attributed his failure to family illness and slack trade. In reply to the Official Receiver, the debtor said he had been a torpedo man in the Navy. He served 10 years up to 1899, and then started on his own account at Brimscombe with a capital of about £60. He had been sued, but delayed filing his petition, hoping work would improve. The examination was closed subject to the signing of notes.

Dissolutions and Liquidations.—General Electric Sign and Engineering Co., Ltd.—A meeting will be held on April 25th, at 28, Basinghall Street, E.C., to hear an account of the winding-up from the liquidator, Mr. Edwin Hayes.

E. Russell & Sons, Ltd., 55, Cross Street, Manchester, electrical engineers, &c.—The first meeting of creditors herein was held last week at Manchester. Mr. Ellis Johnson, the assistant Official Receiver, who presided, said the gross liabilities were £2,575, of which £2 328 was expected to rank for dividend. The assets consisting of stock-in-trade, fixtures and book debts were estimated to realise £250, against which there were preferential claims for wages, &c., amounting to £176. The bulk of the preferential claims were for wages, and these would have to be closely investigated as well as certain allegations of undue preference to creditors, and to one of the directors of the company. Mr. Johnson added that the deficiency account was anything but satisfactory, and pending investigations, the usual statement of affairs, &c., would not be issued to creditors. It seemed inexplicable that the gross profit from October, 1908, down to the date of the winding-up order, showed only £7 3s. 10d. It was clear that the books of the company from the date of the formation in October, 1907, to December of 1908, had not been properly kept, for the payments shown exceeded the receipts by over £90. In answer to questions, Mr. Johnson said that the capital of the company was £2,000, made up of £1,000 in preferential shares of £1 each, and 1,000 ordinary shares of the same value. The paid-up capital was £443, and £200 of that represented the vendor's share. The company was formed to take over the business of Mr. William Edward Russell, at 3,

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Curzon Street, Oldham, and 2, Manchester Road, Hyde, Mr. Russell becoming the managing director. In December last six creditors had obtained judgment against the company, and at an extraordinary meeting of the shareholders on January 3rd, a resolution was adopted for the winding up of the company, Mr. Ernest Bethel Russell being appointed liquidator. It was the opinion of the Official Receiver that the failure of the company was mainly due to the taking of contracts at too low a figure. A creditor asserted that there were cases where contracts had been taken at a price less than the cost of the materials. Mr. Johnson said if that was so it was a gross scandal. He promised that this and other allegations made in the petition would be carefully inquired into. The meeting passed a resolution to the effect that the Official Receiver be continued as liquidator, without a Committee of Inspection.

Private Meeting.—Frederick J. Borland (trading as Frederick J. Borland & Co.), Excelsior Stores, Old Mills, Camp Road, Leeds, late electrical engineer, fancy dealer, &c.—A meeting of the creditors interested in the above matter was held on Wednesday, March 23rd, at the Hotel Metropole, Leeds, Mr. Gill, of Castleford, presiding. The statement of affairs prepared by Mr. Percy Pemberton, incorporated accountant, Greek Street, Leeds, showed unsecured liabilities £625, cash claims £100 and partly secured creditors, of which £87 was expected to rank, making the total liabilities £812. The assets were as follows:—Book debts estimated to realise £140; bill of exchange in hand, £43; making the total assets £183. There were preference claims amounting to £29 16s, the estate disclosing a deficiency of £658. Mr. Pemberton said that in April of last year the stock and plant in connection with the electrical department at Camp Road were valued at £1,704. In July the bank began to press for a reduction of the overdraft, and debtor decided to relinquish the engineering business. Messrs. Batley & Son offered the plant, &c., by auction, the whole realising £240. The debtor hoped, as a result of the sale, to be in a position to pay his creditors in full, but there was an actual loss of over £1,100. In connection with the hardware business, there had been general misfortune, and besides a loss of £122 in the Leeds business, there were deficiencies of £187 at the Harrogate shop, and £62 on the Barnsley branch. The shop at Lancaster was more fortunate, and it was realised without loss. Several executions had been obtained against the debtor, with the result that money was lost heavily through forced realisation. Mr. Turner (Messrs. Turner and Turner, solicitors, Leeds), who appeared for the debtor, said he had hoped to be in a position to make a cash offer to the creditors, and had consulted the debtor's sister with that object. Miss Borland's legal adviser, however, had not favoured the suggestion, and he (Mr. Turner) thought the creditors would have to do the best they could with the estate. Mr. Lockwood, of Sheffield, who represented several creditors, said that a cash payment would be the best in the circumstances, as, owing to the number of small claims, it was almost impossible to realise such an estate under an assignment. The debtor was then called into the room, and greeted by the chairman with a word of sympathy in view of the position. Mr. Borland said he had a partner up to about three years ago. Since then he had put into the business about £2,000 which came from his father's estate. Asked why he had not consulted his creditors earlier, the debtor said he quite expected to have been in a position to have paid everyone in full. In answer to a further question, Mr. Pemberton said that at March 31st last year there was a surplus over liabilities of about £2,000. After further discussion, it was resolved that the debtor be asked to make a cash payment of 5s. in the £ within the next 14 days, failing which a deed of assignment should be executed to Mr. Pemberton as trustee. The following are creditors:—

Société Des. Limatiers	£20	Pistor, G.	£14
Turner & Turner	20	Max Emanuel & Co.	12
Himmell & Co.	23	Sadler, J.	24
Electric & General Stores, Ltd.	30	Partly secured creditors :—	
Ferry Wire Co.	32	"Bankers"	337
Gill & Sons	40	Cash creditors :—	
Davidson & Co.	33	Boggis, H.	75
Buriuraux & Spilmont	19	Borland, Miss	25
Lazarus & Rosenfeld	16	Preferential creditors	29

Electrical Enterprise in Japan.—According to recent reports from Japan dullness still continues in the money market, and deposits are still pouring into the vaults of the banks. This state of affairs has been highly favourable to new business enterprises, and the business world of Japan is now beginning to bestir itself. The latter half of the present year will most likely see a reaction after the business lull of the past year.

At present this activity is strongly felt in electrical enterprises. "The shares of those electric railways, still in course of construction, have risen remarkably in their market value," says a recent number of the *Japan Times*. "It has stimulated many electric railway enterprises in various places, especially in the Kwansai districts, where such enterprises were started but afterwards dropped in view of the financial depression since the year before last. They are now to be revived and may be regarded as forerunners of returning business energy.

Among those in course of construction may be mentioned the Sakai Electrical Railway, connecting Sakai with Osaka; the Kei-Shin Electric Railway between Tokyo and Kobe, a distance of nearly 400 miles; the Nara Electric Railway connecting Nara with Osaka, for which a rival line has already appeared—the Harima Electric Railway; a line between Akashi and Himeji; the Yodo River Water-Power Electricity Co., the plant of which is to be located between Osaka and Kyotot. In this connection it may be noted that there are several lines near Nagoya, such as the Owari Electric Railway, between Ichinomiya and Inuyama, and the Shin-San Electric Railway, which proposes a line from Toyohashi to Lida in Shinano.

The number of companies which have newly applied for charters is by no means small. The prospect of the Hiroshima City Electric Railway is especially bright. The Nishinada Electric Railway, the Settsu Electric Railway, the Osaka Electric Railway, the Rakusei Electric Car Co., and the Azumi Water-Power Electricity Co., are also promising enterprises.

Not only are the prospects good for the new electrical undertakings now under way in various parts of the Empire, but the general outlook for this line of work is so good that some of the old companies have increased their capital and equipped themselves for greater ventures. The Han-Shin Electric Railway Co., whose line between Osaka and Kobe is well patronised, have already begun extending their lines.

It is not to be wondered at that private electrical enterprises in Japan are showing much activity, when we remember that the country is remarkably suited for generating and supplying electricity. So well is this fact recognised over there that the authorities concerned in the Imperial Japanese Government appear strongly to recommend the construction of electric railways for the purpose of taking the place of the existing steam railways.

Such being the case, and in view of the fact that so many influential business men are expected here from Japan this summer as visitors to the Exhibition at Shepherd's Bush, there should be a unique opportunity for British manufacturers and dealers in electrical machines and appliances to extend their business. It should be remembered that there only remain about six weeks to complete the installation of the exhibits before the opening of the Exhibition.

"Avoid being the iris of the 6th day," is an old Japanese adage. It has been customary in Japan from ancient times to have a festival of iris flowers on the 5th day of the 5th month, when all ladies and noblemen of the court used to go out to admire the flower with ceremonies appropriate for the occasion. For an iris to bloom on the 6th would be to miss all the honour of the day of days in its life. The Japan-British Exhibition is to be opened in the early part of May, when the iris pond in the Japanese garden there will be in its glory. Let our manufacturers take heed, lest they be left in the unenviable position of the unfortunate flower to which reference has just been made.

Osram Lamps—Price Reductions.—Elsewhere in this issue will be found an important advertisement by the General Electric Co., Ltd., regarding the prices of Osram lamps. As the company, we know, is opposed to anything in the nature of a suicidal price-cutting campaign, we take it that the reductions are the natural outcome of progress in the manufacturing processes, and increase in the output, of Osram lamps. Hitherto the 17-watt lamp has been taken as a standard, and in order to encourage the use of lamps of higher wattage, the prices of 25 32 and 55-watt lamps have been only 3d. dearer than the above standard, for low-voltage supply; in accordance with this policy, which should appeal to central-station engineers, all lamps for 100-135 volts, from 25 to 55 watts, are now priced alike. The lamps for higher voltages are also reduced by the same amount, except in the case of the 55-watt lamp, which is mainly used for street lighting; this has been reduced to a lower figure, with the object, we understand, of encouraging the development of street lighting by electricity, in competition with gas. An improvement in the efficiency is also announced, which takes the form of a reduction in power consumption of about 10 per cent., without alteration in the candle-power, and this should further assist in the fight between the two illuminants.

A similar announcement has been received as we go to press from Messrs. Drake & Gorham, Ltd., who also supply Osram lamps.

LIGHTING and POWER NOTES.

Aberdeen.—The Corporation Electricity Committee is to receive a deputation from the School Board for the purpose of discussing the charges for electricity used by the Board.

Ardsley.—The B. of T. having written to the U.D.C. respecting the carrying out of the E.L. order, the Council has decided to again ask the Yorkshire Electric Power Co. for its terms for supplying the district.

Auckland.—The B. of G. has decided to have the electric light installed at the new Infirmary.

Australia.—As the result of a poll of the ratepayers of Brighton (Victoria), a general desire was expressed for the Melbourne Electric Supply Co. to undertake the supply in the area. Mr. W. Fink, a rival applicant for powers, having pressed the matter, a further poll was to be taken to see whether the ratepayers would "forbid him to supply electricity."

Barking.—Speaking at the adjourned general meeting of the British Coalite Co., Ltd., recently, the chairman mentioned that the first installation of power plant, 20,000 H.P., for the generation of electricity at Barking, would certainly be running by the end of this year, and negotiations were proceeding for the disposal of the whole of the power.

Bristol.—The T.C. has applied to the L.G.B. for a loan of £1,275 for a 500-kw. converter. This is in place of the loan of £817 for a 300-kw. converter.

Canada.—The Montreal Light, Heat and Power Co. has a claim of $170,000 against the City of Montreal for street lighting for the past 13 months, and has taken legal action. An amicable understanding between the city and the company is now within reach.

The city of Calgary has agreed to take power from the Calgary Power Co. to the amount of 6,000 H.P. at $25 per H.P. for the period of 10 years.

The meter is becoming almost general in Canadian towns. Nelson (B.C.) is the latest town to adopt the meter and abandon the flat rate. It expects an increased revenue of $10,000 by selling current by meter instead of on the present flat rate. The cost of supplying meters will be about $15,000.

Cape Colony.—The Cape Town City Council has adopted the following resolutions relating to the supply of electrical energy:—"(*a*) That rows of houses belonging to one landlord be permitted to be supplied through one meter placed in the end house, provided the landlord undertakes to pay for all energy consumed in one account." (This proposal is merely an extension of the existing regulation, that in the case of large buildings containing offices, one service will be run, and energy supplied in bulk and charged to the landlord.) "(*b*) That the minimum charge for electric lighting be reduced from 10s. net to 5s. per month, and that the reduction take effect as from July 1st next."

Continental Notes.—BELGIUM.—La Société d'Electricite de l'Est de la Belgique is the name of a new company, which has just been formed in Brussels, with a capital of £26,000, to establish a central generating station for the supply of electricity for lighting and power purposes in the Verviers district.

SPAIN.—The firm of Hijos y Nieto de P. Baurier has been authorised to build a dam and make use of water from the River Ter, in the district of Masias de San Pedro de Roda, to a maximum extent of 6,000 litres a second, for the generation of electric power to be used in a cloth factory.

Dumfries-shire.—An electric plant has just been installed at Canonbie Colliery, Dumfries-shire, by the proprietor, the Duke of Buccleuch. The chief object is to recover the good coal below the level of the pit bottom, which had to be abandoned 20 or 30 years ago, owing to the lack of mechanical means of haulage and pumping power. The new plant includes a high-speed engine and dynamo giving 87 amperes at 500 volts. The current is carried down the shaft for about 600 yards, and drives a haulage which brings the coal up in rakes to the level of the pit bottom. The supply down the shaft is by double-armoured cables. The new plant also deals with water, there being a three throw pump, driven electrically.

Harrogate.—The T.C. has decided to apply to the B. of T. for permission to supply current to a number of premises outside the present limits of supply.

Haslingden.—The T.C. has passed a resolution favouring the putting into force of the E.L. order. The Tramway Committee is to consider the cost of generating electricity at Prinny Hill, together with the cost of supplying electricity, if taken in bulk from Accrington or Rawtenstall Corporations.

Heston and Isleworth.—The U.D.C. has agreed to ask the L.G.B. to sanction additional loans of £3,600 for a new 250-KW. triple-expansion engine, condenser, feed-pumps, and other plant. The engineer reported that the recent exhibition was not so well attended as the one held three years ago, but the class of visitor was better.

Ilford.—The U.D.C. has reduced the price of electricity for public lighting as under:—Columns with one single burning or two series burning incandescent lamps, from £3 10s. to £3 7s. 6d. per annum; three-light columns, from £10 to £9 10s. The candle-power of the two-light lanterns is to be increased from 45 to 60.

Kiveton Park.—The R.D.C. has consented to overhead cables being used by the Dinnington Colliery Co. for the transmission of electricity from the colliery to Throapham.

Lancaster.—Last year the income of the Electricity Department for the sale of electricity for lighting was £585 less than the estimate, but the receipts from the tramway supply were about £80 more. The net decrease of £505 is attributed to slackness of trade and the economical lamps now in use.

Llandudno.—The U.D.C. has applied to the L.G.B. for a loan of £1,000 for money overspent on cables, and for prospective expenditure for two years.

Terms are to be quoted for a supply of energy for lighting the station of the London and North-Western Railway Co.

Llanelly.—The Electric Light and Traction Co. has informed the U.D.C. that within a period of nine months it proposes to supply current for public and private lighting.

London.—HAMMERSMITH.—The existing 100-C.P. lamps in Wood Lane from Uxbridge Road to the Exhibition entrance are to be replaced by 200-C.P. lamps on the existing 11 posts. The increase in the annual cost of lighting this portion of the road will be from £29 14s. to £54 15s. The work of extending the main feeder cable along Wood Lane from the Metropolitan Railway bridge to Ducane Road is to be proceeded with, and tenders are to be invited for the supply of cable. The estimated cost is £1,212. It is believed that the demand for electricity north of Ducane Road will be very largely increased next winter.

STEPNEY.—With a view to expediting the contracts with Messrs Strachan & Henshaw, Ltd., E. Danks & Co., Ltd., and C. A. Parsons and Co. for plant at the new power station, the Electricity Committee recommends the B.C. to suspend by-law 53, which entails the sanction of the L.C.C. being obtained before the Council enters into any contract for work to be paid for out of capital. The B.C. has agreed to take a further bulk supply from the Poplar B.C. at ·3d. per unit for untransformed energy.

WOOLWICH.—As a result of negotiations and arbitration proceedings, the Electricity Committee has acquired the freehold and leasehold interest in Roff's Wharf at £12,630.

Methley.—The Yorkshire Electric Power Co. has applied to the B. of T. for consent to the use of overhead wires for the supply of electricity to the district. The U.D.C. has sanctioned the use of such cables.

Newton Abbot.—The Lighting Committee, as a result of the lighting tests, recommends that the tender of the Newton Urban Electricity Supply Co. in £750 for public lighting be accepted.

New Zealand.—The Christchurch City Council has had under consideration the necessity of adopting a larger scheme for electric supply. The chairman of the Lighting Committee said that by utilising Lake Coleridge and several adjacent rivers, 10,000 H.P. could be obtained, and the cost would be about £250,000.

The Borough Councils of Gisborne, Wairoa, Hastings and Napier have been considering a joint hydro-electric scheme at Waikaremoana.—*Australian Mining Standard.*

Penistone.—As the cables are to be extended to the district, the U.D.C. has asked the Yorkshire Electric Power Co. to give an estimate of the cost of driving the plant at the pumping station by electricity.

Runcorn.—With reference to the electric lighting question, which has been before the R.D.C. for some time, the following resolution has been passed by the Council:—"That a prov. order be granted to the Castner-Kellner Co. for a portion of the parish of Weston, immediately adjoining their works, and that such portion of the parish be excluded from the area of the prov. order of Messrs. Cox & Falk. That a right be reserved to Messrs. Cox & Falk to use the roads within the area of the order to be granted the Castner-Kellner Alkali Co. for the purpose of laying cables." The Castner-Kellner Co. has agreed that the maximum charge for lighting within the area shall at no time exceed the maximum charge for the area of the order granted to Messrs. Cox and Falk. The Council has, therefore, consented to the applications of both companies.

Southampton.—The Electricity Committee on Wednesday last week adopted the recommendations of its engineer, Mr. H. F. Street, as to revised charges for power and heating purposes. For power purposes to long-hour consumers, a sliding scale of from 2d. to ¾d. per unit for varying consumptions of energy per H.P. installed has been adopted, while for heating and cooking purposes, the somewhat bold experiment of charging a flat rate of ½d. per unit and no meter rent, is to be made. We compliment Mr. Street and his committee on their courage in attacking this difficult problem and offering such advantageous terms to consumers. If the makers of cooking apparatus and the local contractors only rise to the occasion with reliable cooking and heating appliances, the experience gained should prove invaluable to the industry. Mr. Street has great faith in the efficacy of price reductions for increasing total receipts, and we trust that, even in this instance, his expectations will not be falsified.

Transvaal. — The Roodepoort-Maraisburg T.C. has obtained Government sanction for a loan of £5,000 for electric lighting.

Weymouth.—The Corporation Electricity Department has offered to install the electric light at the workhouse, and supply energy, for £80 per annum, with a reduction of £10 a year after three years, and two further annual reductions of £10 at the expiration of each subsequent sixth year. The matter is under consideration.

The T.C. has adopted a "fixed price light scheme" in connection with the electricity undertaking, and by this means it is hoped to largely increase the number of small consumers. The wiring and fitting will be carried out by contractors.

TRAMWAY and RAILWAY NOTES.

Argentine.—Work on the electric railway between Buenos Ayres and La Plata (Otto Franke concession) is to be commenced on April 15th, according to the *Review of the River Plate.*

The first section of the Bahia Blanca electric tramway has been formally opened.

Australia.—The Perth (W.A.) City Council having rejected the previous proposal of the Perth Electric Tramways, Ltd., that the company's lines should be taken over by the Council at once for the sum of £400,000, instead of in 1939, when they would become the property of the Council without purchase, a fresh proposal has now been made by the company, namely, that the suburban rights, which do not lapse at the same time as the city rights, be bought out at £100,000.—*Australian Mining Standard.*

Bacup.—On March 23rd a through service of electric cars was inaugurated between Accrington and Bacup and *vice versa*, the distance from town to town being 10 miles. The service is to be continued for three months as an experiment, but as there is a great demand for such a service, it is extremely probable that the through service will be made permanent. The first car was driven alternately by the Mayors of Haslingden, Rawtenstall and Bacup, and subsequently a luncheon was served at Haslingden, where the Mayors of the three Rossendale boroughs delivered addresses.

Birmingham.—For the 51 weeks of the last financial year ending March 19th, the aggregate tramway receipts amounted to £293,814, as compared with £281,623 for the corresponding period in the previous year; it is considered that the receipts will show an increase on the year of £12,000 or £13,000.

Continental Notes.—Germany.—Plans are being prepared in respect of a proposed electric tramway between Oberhausen and Dinslaken.

Italy.—The Compagnia Italo-Belga dei Trams Elettrici di Verona is authorised to construct and work a section of electric tramway in Verona, from the Via dei Leoni by way of the Via Leoncino and Via Anfiteatro to the Piazza Bra.

France.—A scheme for electrifying the tramway between Bayonne and Biarritz is at present under consideration.

Edinburgh.—The new plant required by the Corporation in connection with the generation of power for the tramway from Slateford Road to the new markets at Gorgie, includes a generator and switchgear, to be installed at Dewar Place station, and costing £1,400.

Japan.—The Odawara Electric Railway Co. is reported to be preparing plans for the extension of the Komo-Yumoto line to Miyanoshita.

Leith.—Bailie Hall, convener of the Corporation Tramways Committee, speaking at a local gathering recently, said there had been an increase of revenue from the cars from May 15th last up to date of £3,624, as compared with the same period last year. The net increase of expenditure was only £202. By May 15th he anticipated the increase of revenue would be considerably over £4,000.

London.—The new L.C.C. tramway up Highgate Hill was opened for traffic on March 25th. This section replaces the old cable line, and extends from the Archway Tavern to the Old Gate-House Hotel; it is constructed on the conduit system, and the cars are fitted with a slot-rail brake in addition to the usual brakes, owing to the very steep gradient of the route.

Stretford.—The U.D.C. has applied to the B. of T. for a two years' extension from June next for completing the works authorised by the Light Railways Orders of 1906.

Venezuela.—A contract has been signed between the Minister of Public Works and Dr. Aveledo, A. Michaud and J. A. Mosquera, for the construction of an electric tramway between Agua de Maiz and Los Dos Caminos; the concessionaires have the right to extend the line.—*Board of Trade Journal.*

York.—The Tramways Committee of the Corporation reports that from January 20th, when the line was opened, to March 17th, the new tramways from Fulford to Wessgate have carried 228,617 passengers, and the receipts have been £1,048 12s., the receipts per car-mile being 8·41d. The amount authorised to be borrowed under the order is £130,700, and the contracts already entered into, including the purchase of the old tramway undertaking, amount to £115,992, of which £75,111 has been expended to date.

TELEGRAPH and TELEPHONE NOTES.

Cables Repaired.—Ceara-Pernambuco, March 18th; Paramaribo-Cayenne, March 21st.

Wireless Telegraphy.—A Bill has been introduced in the United States House of Representatives requiring all Government vessels which go out of sight of land to be equipped with wireless apparatus. It would include tugs, barges, colliers, revenue cutters and similar craft.—*Electrical World.*

Wireless Telegraphy in the Azores.—A commission consisting of three English and three German engineers was sent out by the Great Eastern Cable Co. at the end of 1908 to superintend the erection of five wireless telegraph stations in the Azores for the Portuguese Government. In spite of landing difficulties at some of the islands, the commission completed its task within the year, and the stations have recently been thrown open for the public service. The central position of the Azores in the North Atlantic makes this installation an important one, as practically all ships leaving the English Channel or the Mediterranean for North or Central America come within its range. The wireless installation will also prove a boon to the inhabitants of the various islands, because the violent storms often cut off intercommunication by sea for months together. The stations are provided with antennæ of specially strong construction, and 50 to 70 metres high.—*Zeitschrift für Schwachstromtechnik.*

Wireless Telephony.—The French Government is equipping the two battleships *Justice* and *Vérité* (both of the Mediterranean Fleet) with apparatus for communication by means of wireless telephony on the system invented by Capt. Colin and Lieut. Jeance, with which communication has been carried on between Toulon and Port Vendres, in the Mediterranean, a distance of more than 150 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—April 9th. Generating station building, plant, battery, cables, &c., for the U.D.C. See "Official Notices" March 18th.

Australia.—May 3rd. Sulphate of copper, for the P.M.G.'s Dept. in all States. Tender forms, &c., may be obtained at the Commonwealth Office, London, S.W. See "Official Notices" to-day.

Queensland.—June 8th. Six sections of common battery switchboard and equipment, jumper wire, and cable, for the P.M.G.'s Dept. Tender forms, &c., at the Commonwealth Office, London, S.W. See "Official Notices" to-day.

May 17th.—1,010 reinforced concrete telegraph poles, for the P.M.G.'s Department, Victoria. Forms, &c., at the Commonwealth Offices, London. See "Official Notices" to-day.

May 18th.—Paper-insulated, lead-covered, and brass ribbon-tape cable, for the P.M.G.'s Department, Queensland. Forms, &c., at the Commonwealth Offices, London. See "Official Notices" to-day.

Austria-Hungary.—June 6th. H.M. Consul-General at Budapest reports that tenders are invited by the Municipality of Pécs for the building and working of an electric railway in that town. Tenders to the Pécs város gazdasági tanácsnokának, Városi Székház, Pécs, Hungary, from whom also detailed conditions and forms of tender may be obtained at a cost of 2 kronen (1s. 8d.). The plans and other documents can be examined on personal application at the Engineering Office of the town of Pécs.—*Board of Trade Journal.*

Buenos Ayres.—The *Review of the River Plate* states that the municipality will shortly call for tenders for the renewing of the electric light installation in the Municipal Palace. The work is estimated at about $20,000 m/n.

Chorlton.—April 11th. Wiring, &c., for E.L. at the "Ins and Outs" Homes, Cavendish Road, West Didsbury, for Chorlton B.G. Chas. Clegg & Sons, architects, 21, Spring Gardens, Manchester, (returnable deposit, 10s.).

Colwyn Bay.—April 9th. Stores for the U.D.C. Electricity Department. See "Official Notices" March 18th.

Germany.—Tenders are about to be invited by the municipal authorities of Weissenfels for the establishment of a central electric lighting station in the town, at an estimated cost of £35,000.

Glasgow.—April 4th. Wheels, axles, cables and various other materials, for the T.C. Tramways Department. Mr. A. W. Myles, Town Clerk.

Gloucester.—April 2nd. Electric lighting of the Shire Hall extensions. See "Official Notices" March 11th.

Littleborough.—May 2nd. H.T. feeder cables, L.T. distributors, &c., and transformer kiosk, transformers, equipment, switchgear, &c., for the U.D.C. See "Official Notices" to-day.

London.—L.C.C.—April 20th. Wiring and fitting for electric lighting at Shelburne Road and Torriano Avenue Schools. See "Official Notices" to-day.

Hackney.—April 7th. Flame lamp carbons for the Electricity Department. See "Official Notices" March 18th.

(Continued on page 519.)

THE DUNDEE MUNICIPAL POWER PLANT.

The city of Dundee is the centre of the jute industry in Great Britain, importing, roughly, 220,000 tons of jute annually, and it contains about 100 mills and factories, having an aggregate horse-power approximating 60,000.

Shipbuilding and iron foundries also provide employment for a large portion of the inhabitants.

Although Dundee was one of the first towns to undertake the supply of electricity, it is only within recent years that the business has really developed to any great extent.

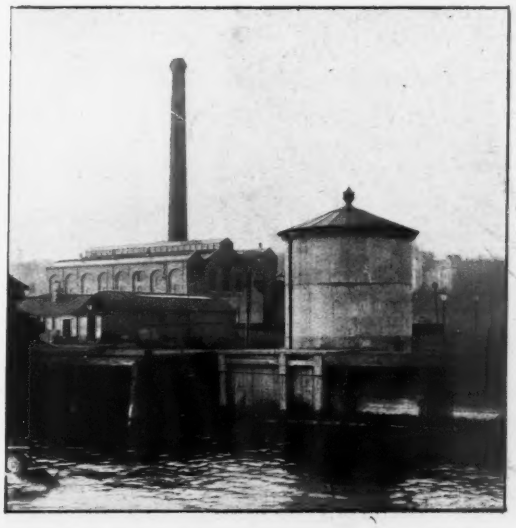
A few years ago, however, it was realised that a modern power plant would shortly be a necessity, and reports and estimates for a scheme were obtained from Mr. H. Richardson, the city electrical engineer, and after consultation with Mr. J. F. C. Snell on the matter, the Council proceeded with the work, placing the responsibility for the design and execution of the whole system in the hands of Mr. Richardson, who advised the adoption of an extra H.T. alternating-current three-phase plant, supplying current at 6,600 volts, 50 cycles per second, together with three sub-stations for feeding the three-wire direct-current network with 400 volts across the outers for lighting and power, and the tramway system.

This installation, which has cost over £100,000, has now been partly in operation since July last year, and so far has proved eminently satisfactory in every way; the official inauguration took place on February 23rd last.

With a capital expenditure of £242,552, the revenue last year from the sale of energy was £36,975. Although the accounts have never shown profits of large dimensions, still the fact must not be lost sight of that for several years now it has been the custom of the department to steadily reduce the capital debt of the undertaking. This has been done by transferring large sums annually from capital to revenue, and with the cost of the large alterations which were carried out earlier, and which were also paid for out of revenue, the sum of £31,500 has been paid out of the revenue account during the last five years, an average of £6,300 per annum.

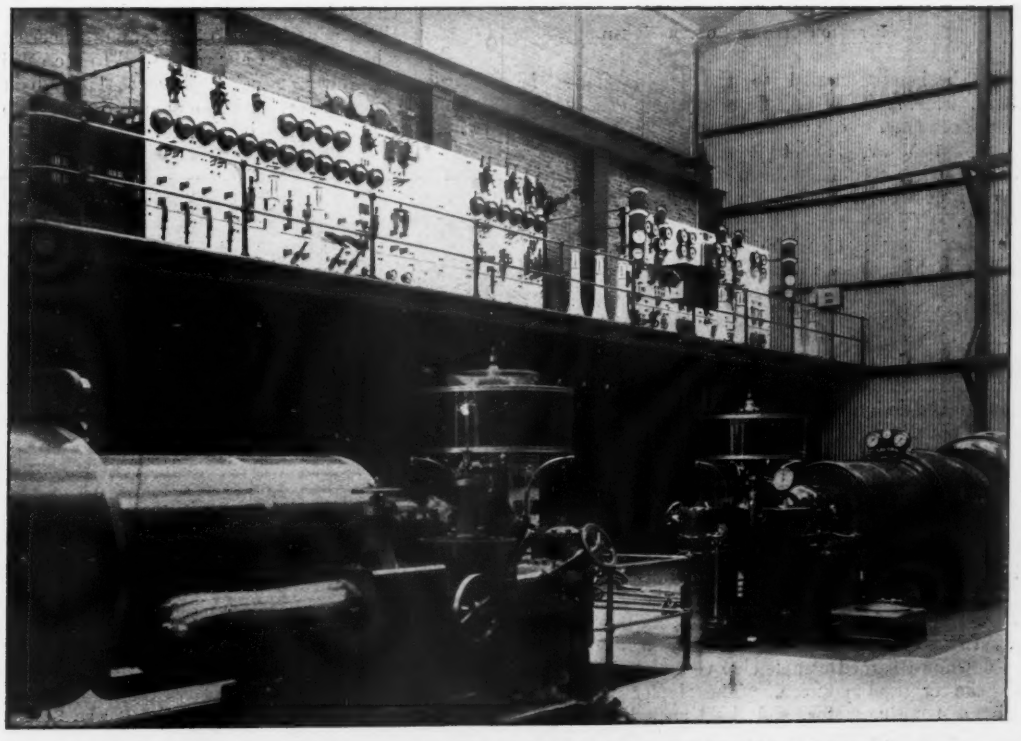
The new generating station is situated at Carolina Port, about 1½ miles from the centre of the city and 560 ft. from the River Tay. The site occupies an area of, roughly, 1 acre, but there is ample ground in the vicinity for extensions.

The present buildings consist of a steel framework filled in with brickwork on three elevations, a temporary corrugated iron screen wall forming the west elevation to allow for easy extensions.



The New Dundee Power Station, Circulating Pump Chamber in Foreground.

A distinctive feature of the buildings is the large windows in the north and east elevations; the boiler house especially is well lighted.



Interior of New Dundee Power Station, Showing Turbines and Control Switchgear.

The ground upon which the station is built was reclaimed from the river some 20 years ago, and over 300 reinforced concrete piles were driven down to the rock and a raft varying

in thickness from 4 ft. to 4½ in. constructed, to carry the buildings, &c.

The engine room is 120 ft. long and 50 ft. wide; the upper floor is of reinforced concrete on the Columbian system, and the lower floor at one end is used for sub-station machinery.

Interior of the Boiler House.

The switch house, parallel to the engine house, is 15 ft. 3 in. wide, and has four floors, of which the E.H.T. switch gear occupies three, and a battery the fourth. The boiler house is 105 ft. long and 40 ft. wide, and provision in height has been made for thermal storage should conditions warrant the adoption of this in the future.

The bunker house is also 105 ft. long, 20 ft. wide and 65 ft. high from the ash basement level to the eaves.

A small workshop, store and lodge are situated at the north-east corner of the site, and a weigh house and locomotive shed are also provided.

As far as practicable the unit system has been carried out in the design of the work. The station as at present put down is complete and symmetrical on either side of its north and south centre line.

In the arrangement of the buildings, the possibility of future use of gas engines and gas generators, if they become more reliable and smaller, has been kept constantly in view.

Coal is delivered over a branch railway, and passes over a 20-ton weighing machine to a large ring tippler situated over a receiving hopper. In the tippler the wagons after being clamped down are turned completely over, coming back to the original position. The tippler is driven by a 4-B.H.P. motor, and the time taken to make a complete revolution is two minutes. The rings are weighted at the top to give a central centre of gravity when turning with a wagon, and an ingenious lock prevents the tippler from being turned without a wagon in position.

The wagons are handled by an electric locomotive supplied by the British Thomson-Houston Co., Ltd., and supplied with energy from overhead wires by two trolley arms. There are two motors and the locomotive is capable of pulling a load of 20 tons up an incline of 1 in 60 at 6½ miles an hour. The receiving hopper into which the coal is dumped has a capacity of 18 tons; a tray conveyor carries the coal from this hopper to a rotary filler, feeding the main gravity bucket conveyor, which lifts it to the overhead bunkers.

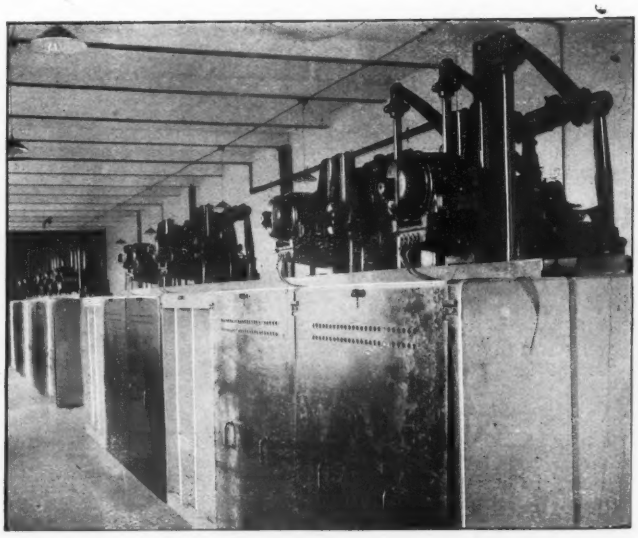
The gravity bucket conveyor, supplied by Babcock and Wilcox, Ltd., is about 326 ft. long, has a vertical lift of 62 ft., is driven by a 6-B.H.P. motor, and runs at a speed of 50 ft. per minute. The coal is tipped into the bunkers by means of tippers, of which there are two to each bunker.

The overhead coal bunkers have a capacity of about 700 tons and are situated above the firing floor. They are built of steel plates stiffened by angles and tees, the bottoms are ⅜ in. thick and the sides and bulkheads, $\frac{5}{16}$ in. Special attention was given to the riveting to have the bunkers as far as practicable water tight.

The coal passes through a valve at the bottom of the bunker into measuring machines where the amount is registered, then by way of shoots to the stoker hoppers. The measuring machines run on rails suspended from the bunkers, but the shoots are fixed. Coal may be taken from either of two bunkers to either of two boilers in a battery.

At present there are four Babcock & Wilcox water-tube boilers each having a heating surface of 6,182 sq. ft. and rated to evaporate 20,000 lb. of water per hour with a working pressure of 180 lb. per sq. in. The boilers are each fitted with a superheater which gives a superheat of about 150° F.; also two chain grate stokers driven by means of chains from a main shaft in the ash basement.

The driving motors are situated between the batteries of boilers in a room at the ash basement level. These are 8 B.H.P. each, and are controlled from the firing floor, each motor being capable of driving the eight stokers. The ashes are discharged through dumping doors at the back of the chain grates to the ashpits underneath, from which they are allowed to fall to the ash basement floor. After they are cooled, they are taken by the main conveyor to an ash bunker and discharged into railway wagons or carts as may be desired.



Main Oil-Switch Gallery, Dundee New Power Station.

Special attention has been given to making the flues as short as practicable, with easy curves and rounded corners. To facilitate the cleaning of the flue, sliding doors have been provided in the bottom of the main flues, so that the soot may be dropped into barrows at the ash basement level,

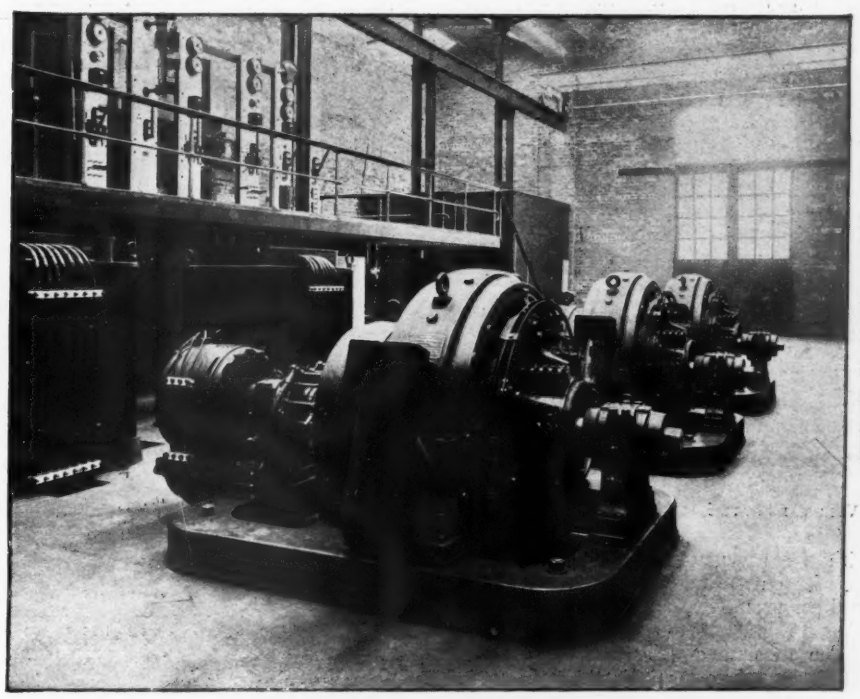
and taken to the main conveyor. There are two economisers of 360 tubes each, situated on either side of the chimney, one for each battery of boilers; these are erected above the main flues, and provided with dampers of the horizontal butterfly type.

The soot pit under each section of the economiser is formed with a double slope leading to a trough at the bottom where a screw conveyor driven by means of a clutch from the scraper gear, discharges the soot into trucks; it is then taken by the main conveyor to the ash bunker.

The economiser scraper gear is driven by a 4-B.H.P. motor, situated at the level of the top of the economiser.

There is one brick chimney, 9 ft. internal diameter and 200 ft. high above the firing level.

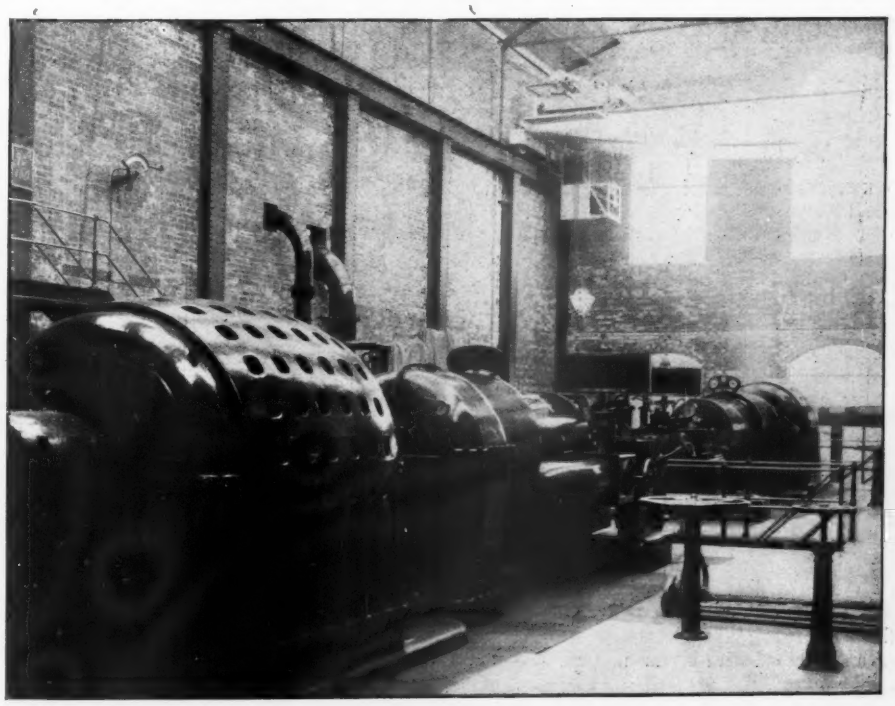
In the boiler house there are a Simmance Abady combined CO_2 and draught recorder, large illuminated dial steam pressure gauge giving the steam pressure in the main steam pipe, and a recording steam pressure gauge.



Typical Rotary Sub-station, Dundee.

Two steam-driven Weir feed pumps, each capable of delivering 8,000 lb. of water per hour against the boiler pressure of 180 lb. per sq. in., are installed in the engine room. Besides the ordinary stop valve at the pump there is a valve with a long spindle extending through into the boiler house with which the firemen can regulate the speed of the pump. Above the wheel on this spindle in the boiler house is a gauge showing the pressure of the feed water, and on this gauge the strokes of the pump can be plainly observed. As the pump exhaust is not free from oil it is not allowed to mix with the turbine exhaust, but is passed through a coil in the hotwells where the otherwise waste heat is taken advantage of to heat the feed water, and the condensed steam is run to the drains.

The main and branch steam pipes to the turbines are of mild steel, 8 in. in diameter, with branches and flanges riveted on. The main steam header is securely anchored in the middle of each battery of boilers and an expansion bend is fitted between the batteries; the expansion bend was sprung cold, when being erected, by an amount equal to half the maximum total expansion when working. There is a mild-steel steam separator for each turbine on the engine room lower floor, with a Pool trap discharging the condensed steam either to the hotwell or to the drains.

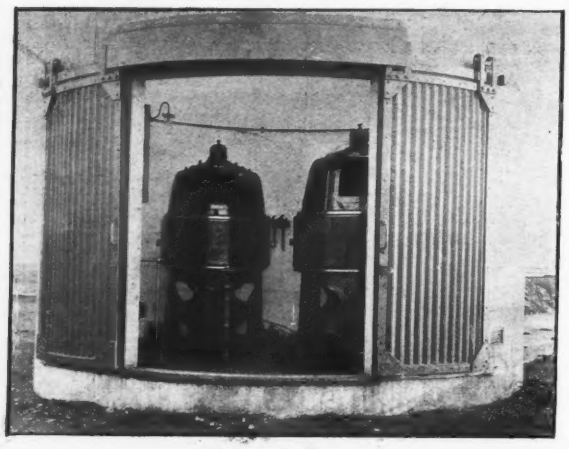


Willans-Dick, Kerr Turbine Plant, Dundee.

In the engine room are two Willans-Parsons turbines of 2,000 kw. each, capable of dealing with overloads of 25 per cent. for two hours and 50 per cent. for half hour. Each turbine is fitted with a hand-operated overload valve which admits high-pressure steam to the second expansion rings, a governor with electrical control, oil pump and tachometer. A hand oil pump is also provided to flush the bearings before starting.

Each turbine exhausts into a Contraflo surface condenser of 3,400 sq. ft. cooling surface in the basement. To allow for

expansion and prevent distortion of the turbine body, the condenser rests on springs and is not rigidly fixed. Motor-driven three-throw Edwards air pumps are provided



Vertical Shaft Motors Driving Circulating Pumps, Dundee.

with force pumps, which lift the discharge to a Lea recorder on the upper engine room floor where the steam used per hour is continuously recorded, the water being then allowed to gravitate to the hot wells.

The circulating water for the condensers is taken from the River Tay; details of the arrangement adopted will be referred to later.

The turbines are each coupled to a 2,000-KW. three-phase generator giving 6,600 volts and 50-cycles when running at 1,500 R.P.M.; an 18·5 KW. 125-volt exciter is coupled up to each generator shaft. The stator body is in one piece and is arranged to slide lengthways along the shaft to give access to the rotor. Natural ventilation is used, cold air being drawn through air passages from below. Two auxiliary direct-current Willans-Siemens generators are used as a stand-by for exciting the main generators or driving the works motors. Other auxiliary plant includes a small booster consisting of a 23-B.H.P. motor and 15 KW. generator, used for charging the battery; two motor-generators, one a single-ended machine consisting of a three-phase 6,600-volt motor coupled direct to a 300-KW. direct-current generator supplying at 400/460 volts; and the other, a double-ended machine consisting of a three-phase motor in the centre, driving two direct-current generators of 150 KW., giving 200/230 volts. These motor-generators are used for feeding the district round the station and for works motors, &c. In the engine-room there is a 25-ton, three-motor travelling crane supplied by Alexander Jack & Co.

The battery, situated on the fourth floor of the switch-house, consists of 102 Tudor cells; special care was taken to make the battery room floor acid-proof, blue adamantin clinkers being laid on cement and grouted with bitumen.

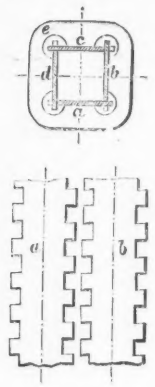
(*To be concluded.*)

Ventilation of Public Buildings.—The Royal Sanitary Institute have appointed Prof. Henry Adams, of the firm of Henry Adams & Son, and Dr. Louis C. Parkes as their representatives upon a joint committee which is being formed by the Institution of Heating and Ventilating Engineers to consider the question of legislation in connection with the ventilation of public buildings.

FONTANA POLES.

By Dr. ALFRED GRADENWITZ.

Strange though it seems to utilise perfectly elastic thin steel bands without the intermediary of any rivets, screws, clamps or the like, merely by the meshing of their toothed edges, for the production of an absolutely rigid extensible pole of high stability, this idea has been recently carried into practice by a Berlin engineer, Herr Alexander Siewert. His Fontana poles, as they are called, aroused quite a sensation at the International Aeronautical Exhibition at Frankfurt-on-Main, by the ease with which they could be folded up and down without showing any discontinuity throughout their length.



Figs. 1 and 2.

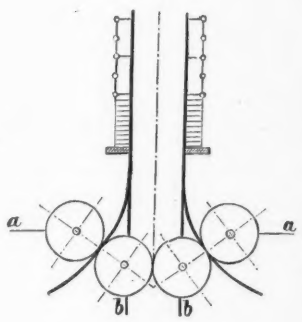
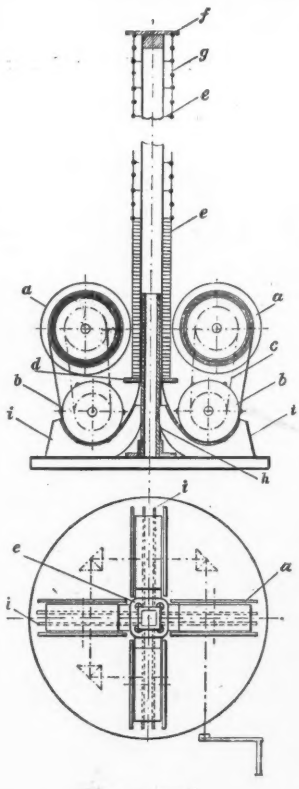


Fig. 3.



Figs. 4 and 5.

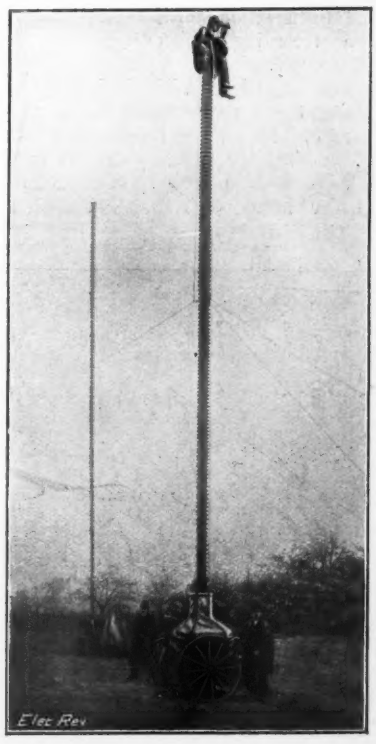


Fig. 6.—Fontana Pole for Look-out Purposes.

In connection with such telescopic poles as have been previously constructed of tubes sliding inside one another with as little play as possible, there was hardly any possibility of supporting any considerable load, while the risk of rusting and obstruction by sand, dust, snow and ice could not be effectively avoided. Now all these drawbacks, as will be seen from the following, are entirely eliminated in the case of the Fontana poles on account of the perfect originality of their design. The first poles of this kind were designed with triangular profiles, but, owing to the unsatisfactory utilisation of the material, these profiles were soon replaced by quadrangular, and, later on, partly by hexagonal cross-sections. Because of practical reasons no further approach to the circular profile, which would be the most advantageous, according to theory, for withstanding wind pressure was made; the more so, as

only a slight further increase in the stability of the structure could be thus expected.

Fig. 1 represents a rectangular pole; *a b c d* are four bands running continuously in a vertical direction, which, as seen from fig. 2, are provided with tooth-shaped projections. The projections engage with the corresponding gaps in the contiguous band, thus fixing inwardly the profile. Thin disks (as in fig. 1), which tightly encompass the profiles, prevent the bands from deviating outwards.

The drive which effects the lifting and lowering of the poles is adapted to the special purpose for which the structure is intended, as well as to the stability desired. In the case of transportable poles, a considerable speed in lifting and lowering is generally required, whereas with stationary plants the pole has to be folded down, if ever, after months or years. In connection with transportable poles, it is of importance to reduce the driving gear, as well as the folded pole to small dimensions, while keeping the weight of the whole within narrow limits. That the constructor has succeeded in attaining this result, may be gathered from the fact that a pole used for the purposes of wireless telegraphy, with a useful height of 20 metres, only requires, when folded down, a ground area of 1 sq. metre, its height being about 1·7 m., and its weight about 175 kg. In the case of such poles, especially when considerable stability is desired, the drive is mostly effected by drums, as represented in figs. 4 and 5. From the rollers *a* the metal band passes on to the drums *b*, which work partly as driving drums, and partly as guiding rollers. In figs. 4 and 5 are shown two driving drums and two guiding rollers, the former comprising in their middle two rims meshing with the corresponding notches in the bands. The drums and rollers *b* are connected by chains with the winding rollers *a*.

From the driving drums the metal band is led on to the plate *d*, designed like the disk *e* in fig. 1, and which is rigidly connected with the driving gear. By meshing together their toothed edges, the bands are fixed inwardly. On the plate *d* are accumulated the profile disks *e*, which are to be distributed at given distances throughout the height of the poles. As the drum *b* revolves, the metal bands are passed through the plate *d* and the accumulated profile disks *e*, the head disk *f* carries along by means of joints *g*, the uppermost profile disk, which, in its turn, is connected by similar joints with the following disk, &c. By varying the length of the joints the mutual distances of the profile disks, as these distribute themselves over the height of the pole, are controlled at will. The pillar *h*, which penetrates into the bunch of profile disks, is intended to deal with any deflection and vertical thrusts, transmitting them to the ground plate. To this effect the bands, after the pole has been lifted, are pressed against the pillar by clamps. The guiding plates *i*, surrounding the drums, prevent any bulging on the latter.

The drive is effected by means of intermediate gearing directly on to the shaft of one of the drums *b*, which are coupled together by beveled wheels. As those bands which are not driven are carried along by the teeth of the driven ones, it is not necessary to design all the drums as driving drums. Owing to the remarkable strength of the bands, which are made of case-hardened crucible steel or Swedish steel of natural hardness, the diameters of the winding and driving drums can be designed relatively small, thus reducing the driving gear to small dimensions.

The height of the pole, when folded down, is mainly controlled by the height of the heaped-up profile disks. As the bands only exert a very slight lateral force on the disks, the latter can be made very light, *e g.*, of thin steel sheet.

In the case of lighter poles, used for supporting the antennæ in wireless telegraphy, this kind of drive is replaced by friction rollers, as represented in fig. 3. Two of the bands of the poles (which in this case are mostly of quadrangular cross-section) are driven by the steel rollers *a* and *b*, pressed against one another by springs. The drive is effected from the axle of one of the rollers *a*, which is coupled by toothed wheels to the other rollers. This design allows the height of the structure, when folded down, as well as its weight, to be reduced even further than with the driving gear at first described.

Again, in the case of poles which have to support specially heavy loads, the drive is effected by some kind of pump handle, actuating a cam in the middle of the pole, which, in connection with pawls engaging with the toothed gaps of the metal bands, causes the pole to be lifted. The unfolding of hexagonal poles is effected in the same way as in figs. 4 and 5, but three bands, in place of two, are generally driven.

Fig. 6 represents a view of a Fontana pole, used as a look-out, the seat fixed on to the top being rotated in any direction by means of a set of gears. The whole mechanism in the folded condition is included between two light travelling wheels, hardly reaching to the height of a man. It is lifted in a few minutes to the considerable height of 20 to 25 metres, a single operator being required to do this.

The possibilities of application opened up to the Fontana pole are obviously many. Apart from their use for antenna masts and transmission poles, may be mentioned the construction of signalling and look-out poles for warships, supports of search-lights, protective nets for torpedoes, &c., and other military applications. The quickness of erection, and the small space requirements, of Fontana poles will be specially appreciated. There is hardly any possibility of the apparatus failing to work, even in the event of its being operated by a non-skilled crew. In order to protect the poles against the projectiles of the enemy, the driving gear can be provided with a suitable armour, while any section destroyed is readily cut off and supplemented by the stock wound up in the drums.

Fontana poles will also be found useful in building, the installation of transporting plants being greatly facilitated by the application of the new system. In this connection stationary poles of considerable height (20 to 150 metres) can be used such as have been so far mostly designed as iron or wooden framework structures. Especially in those countries where transportation is difficult, they can be advantageously substituted for the ordinary scaffolding. Owing to the use of high-grade material the width of such supports is reduced considerably, thus offering a much smaller surface to wind pressure. The weight to be transported is obviously reduced in its turn, and the winding engines used are of light weight and are readily dismounted. In the case of stationary poles the profile disks are replaced by clamps surrounding the pole, and fixed by screws, no joints being required in this connection.

By choosing the distance apart of the disks somewhat greater than corresponds to the strength of the bands, the risk of the bands being crushed or torn in the case of accidental overload (*e g.*, on their falling down) is effectively avoided, the bands merely issuing from the profile. In order further to test the strength and possibilities of these structures, a pole 25 metres in height was overturned three times in succession, after which it could be erected again within ten minutes without having suffered any damage.

CONTRACTS OPEN.

(*Continued from page* 514.)

Netherlands.—April 19th. Tenders are invited for the installation of an electric lighting and power plant, including the laying of underground cables, &c. Tenders to Heer Administrateur der Godshuizen, Gasthuisstraat 9, Hertogenbosch. Plans and specifications may be purchased from the same official on payment of 12 gulden (20s.).—*Board of Trade Journal.*

New Zealand.—For a theatre which is being built at Auckland, N.Z., electric lighting plant is to bought in London. The name of the firm of builders can be ascertained from the Board of Trade Commercial Intelligence Department in London.

Partick.—April 6th. Cables, meters and other stores, for the Electricity Department. Town Clerk, Mauldslie Street, Partick.

Pontypridd.—April 11th. Tramwaymen's uniforms, for the U.D.C. See "Official Notices" to-day.

Rotherham.—April 6th. Electrical installation at the South Grove Upper Standard School, for the Education Committee. See "Official Notices" to-day.

Roumania.—The municipal authorities of Tecuciu have just invited tenders for the establishment of a central electric lighting station in the town.

Wallasey.—April 18th. Stores for the U.D.C. Electricity Department. See "Official Notices" March 18th.

Walthamstow.—April 22nd. One feeder booster set, and switchboard and accessories. See "Official Notices" to-day.

CLOSED.

Beckenham.—The U.D.C. has accepted tenders as follows:—

Meters.—Gillespie & Beales.
Engine oil.—C. C. Wakefield & Co.
Cylinder oil.—Englebert & Co.
Service boxes and cut-outs.—W. Lucy & Co.

Burnley.—The Board of Guardians have accepted the tender of Messrs. Carter & Co. to supply their electrical requirements for 12 months.

Bury.—The Electricity Committee has accepted, for the new power station, the tender of Messrs Newton Chambers & Co., Ltd., for a cold water tank; that of the Staveley Coal and Iron Co., Ltd., for iron pipes; that of Messrs. Herbert Morris & Bastert, Ltd., for a 20-ton crane; and that of Messrs. Hayward Bros. & Eckerstein, Ltd., for a platform for high-tension switchboard.

Coventry.—The tender of Messrs. Burbury & Co., of Coventry, has been accepted for the E.L. installation in the extensions at the Coventry and Warwickshire Hospital.

Croydon.—The T.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for a year's supply of cables.

Dewsbury.—The T.C. has accepted the tender of the British Westinghouse Co., Ltd., for a mixed-pressure turbine.

Glasgow.—The T.C.'s Sub-Committee on Tramway Works has recommended acceptance of the following:—

Armature coils.—British Westinghouse Co., Ltd.
Gangways and handrails for Pinkston power station.—P. & W. MacLellan, Ltd.
Scrubber blocks.—Chas. Churchill & Co., Ltd.

For the two pumps at Gilshochill, the following offers for the erection of one each have been accepted:—

British Electric Plant Co., Ltd., Alloa	£172
Mather & Platt, Ltd., Manchester	185

Government Contracts.—The following tenders have been accepted by the Government Departments named:—

India Office, Store Department.

Electrical construction work.—A. Wiseman, Ltd.
Electric power plant.—British Westinghouse Electric Co.
Motors.—Lancashire Dynamo and Motor Co. (two contracts); Laurence, Scott & Co.
Switchboards and switchgear.—British Thomson-Houston Co.
Wire and cable.—Callender's Cable and Construction Co.

General Post Office.

Cable, paper-core.—British Insulated and Helsby Cables, Ltd.; Johnson and Phillips, Ltd.; Siemens Bros. & Co., Ltd.
Insulators.—Taylor, Tunnicliff & Co., Ltd.
Telephones.—British Insulated and Helsby Cables, Ltd.; Siemens Bros. and Co., Ltd.
Telephone transmitters.—Western Electric Co., Ltd.
Wire, Copper.—British Insulated and Helsby Cables, Ltd.; T. Bolton and Sons, Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., Ltd.; Wilkes, Sons & Mapplebeck, Ltd.
Battery equipment and main switchboard with motor-generators, installation at the new head Post Office. Sheffield.—General Electric Co., Ltd.
Electric lifts (2) at the new Post Office, Sheffield.—A. W. Penrose & Co., Ltd.
Electric lifts (3) at the western district Post Office, Wimpole Street, W.—A. W. Penrose & Co., Ltd.
Electric lighting and cabling of King Edward Building, General Post Office, E.C.—G. E. Taylor & Co.
Motor-generators at King Edward Building, General Post Office, E.C.—British Westinghouse Electric and Manufacturing Co., Ltd.
Pneumatic plant installation at the new head Post Office, Grimsby.—C. and A. Musker (1901), Ltd.
Supply and draw-in feeder and pilot cables between sub-stations at G.P.O. (South), G.P.O. (West), and King Edward Building, E.C.—Siemens Bros. and Co., Ltd.
Telephone trunk service equipment, installation at Post Office trunk exchange, Nottingham.—British Insulated and Helsby Cables, Ltd.

Hastings.—The T.C. has accepted the tender of W. T. Glover & Co., Ltd., for Distrine paper-insulated and lead-covered cables.

Heston and Isleworth.—The following tenders have been accepted by the U.D.C.:—

India-rubber tape.—B.I. and Helsby Cables, Ltd.
Electric lamps.—Maxim Lamp Works.
Various articles.—General Electric Co.
Cables.—W. T. Henley's Telegraph Works Co.
House-service and other boxes.—W. Lucy & Co., Ltd.
House fuse-boxes.—B.I. and Helsby Cables, Ltd.
Earthenware troughs.—Doulton & Co., Ltd.
Meters.—Ferranti, Ltd.
Slot meters.—Mordey Fricker Electricity Meter Co.

Huddersfield.—The T.C. has accepted the tenders of the British Westinghouse Co., Ltd, and Ferranti, Ltd., for transformers and switchboards.

Kingston-on-Thames.—The T.C. has accepted the tender of the Craig Park Cable Co., for half a mile of ·1 sq. in. cable, at £176, and for half a mile of 50-ampere low-tension cable, at £125.

London.—Poplar.—The B.C. received the following tenders for extensions to meet next winter's load:—

Cables.

Western Electric Co. (accepted at £3,959).—(*a*, E.H.T.), £1,800; (*b*, L.T., plain lead), £1,045; (*c*, L.T., jute-served), £1,114; (*d*, total), £3,959.
W. T. Henley's Co.—(*a*) £1,850, (*b*) £1,075, (*c*) £1,155, (*d*) £1,080.
Callender's Cable Co.—(*a*) £1,870, (*b*) £1,077 10s., (*c*) £1,150, (*d*) £4,097 10s.
Siemens Bros. & Co.—(*a*) £1,860, (*b*) £1,085, (*c*) £1,161, (*d*) £4,106.
B.I. and Helsby Cables.—(*a*) £1,866, (*b*) £1,102, (*c*) £1,177, (*d*) £4,146.

Switchgear.

Johnson & Phillips, Ltd. (incomplete)		£471
British Westinghouse Co.	(accepted)	484
Ferranti, Ltd.		486
British Thomson-Houston Co.		516

It was pointed out that the whole of the additional panels to the switchboard at the main station and Glengall Road sub-station, since 1904, had been supplied by the British Westinghouse Co., and had given satisfaction.

Converting Plant.

British Westinghouse Co., Ltd., motor-generators		£2,700
Bruce Peebles & Co., motor-converters..	(accepted)	2,785
British Westinghouse Co., Ltd., rotary converters		2,810
British Thomson-Houston Co., Ltd., motor-generators		3,115
Dick, Kerr & Co., motor-generators		4,160

The engineer, in suggesting the acceptance of the tender of Messrs. Bruce Peebles & Co., reported:—"(1) The efficiency of Westinghouse motor-generators is 4 per cent. below Bruce Peebles converters at full load, and 5 per cent. at half load. On the other hand, the overall efficiency of rotary converters is given as 4½ per cent. higher at full and half loads. There are, however, several reasons why it is considered inadvisable to install either motor-generators or rotary converters to run in conjunction with the present plant. The actual efficiencies are as follows:—Full load: (*a*, motor-generator), 86 per cent.; (*b*, rotary converter), 94·5 per cent.; (*c*, motor-converter), 90 per cent.; half load: (*a*) 82 per cent.; (*b*) 91·7 per cent.; (*c*) 87 per cent. (2) In the interest of standardisation it is inadvisable to depart from the present type of converting plant. (3) Motor-generators and rotary converters of this size would not, in my opinion, be suitable for starting-up from the A.C. side without the installation of a separate induction motor to run up to speed, and thus entail the addition of complex switch-gear. (4) Less floor-space is required for motor-converters, practically about one-third less than motor-generators, and slightly less than rotaries, when including requisite room for transformers. (5) The power factor varies considerably with the lesser loads on motor-generators, whereas with motor-converters the power factor can be kept practically at unity throughout all loads. In addition to this, the motor-converter can be kept, if necessary, with a leading power factor, which is impossible with motor-generators. (6) There is a greater tendency for the rotary converter or motor-generator to fall out of step than a motor-converter. (7) There is a greater tendency to flash-over and reversal of polarity with rotary than with motor-converters. Apart from the foregoing reasons for continuing the existing type of converting machinery, it is important to bear in mind that the wave form of the alternators now running is in uniformity with the wave form of the converting plant, and that any change in type of plant should be avoided."

Battersea.—The B.C. has accepted the following tenders for annual supplies to the electricity department:—

Oils.—Price's Patent Candle Co.
Engine-room stores.—Pryke & Palmer.
Packings.—R. Beldam & Co.
Nernst lamps and globes.—Electrical Co., Ltd.
Carbon-filament lamps.—British Thomson-Houston Co., Ltd.

L.C.C.—The Highways Committee has received the following tenders for smiths' shop equipment for the central car-repair depot:—

Standard Engineering Co., Ltd.	(accepted)	£1,367
Westminster Ventilating Co. (not to specification) ..		1,386
Alldays & Onions Pneumatic Engineering Co., Ltd. ..		1,483
S. H. Heywood & Co., Ltd.		1,552
Heenan & Froude, Ltd.		1,636

Estimate of the chief officer, £1,550.

The Committee has also received tenders for 2,000 steel fish-plates from the following firms:—

Walter Scott, Ltd., Leeds	(accepted)	£10 10 0 a ton.
P. & W. MacLellan, Ltd., Glasgow		13 13 9 ,,

Six firms were invited to tender, but four were unable to do so on account of the quantity of fishplates required (27 tons) being too small to cover the cost of cutting the necessary rolls.

Camberwell.—The B.C. has accepted the tenders of the British Thomson-Houston Co., Ltd., and Messrs. Pooley & Austin for the annual supply of electric lamps.

Southampton.—The T.C. has accepted the tender of William Dibben, at £21 3s. 6d., for the annual supply of electric lamps to the Water Department.

Tasmania.—We read in the *British Australasian* that the Launceston Tramways Committee has accepted the tender of Jones & Co., of the United States, for the supply of rails for the tramways, at £9,133.

Walthamstow.—The U.D.C. has placed contracts for annual supplies for the electricity and tramway departments with the following firms:—

W. T. Henley's Telegraph Works Co., Ltd.; Liverpool Electric Cable Co., Ltd.; Siemens Bros. & Co., Ltd.; British Electrical Trade Supply and Bitumen Co.; General Electric Co., Ltd.; Johnson & Phillips, Ltd.; Chamberlain & Hookham; Ferranti, Ltd.; The Electrical Co., Ltd.; British Westinghouse Co.; A. B. Gross & Co.; Maxim Lamp Works; Sunbeam Lamp Co.; B.T.-H. Co.; Davis Electrical Co.; Cresswell's Asbestos Co., Ltd.; Witty & Wyatt; Sloan Electrical Co., Ltd.; Ship Carbons, Ltd.; J. W. Rowlands & Co.; Anti-Attrition Metal Co.; Brecknell, Munro & Rogers, Ltd.; Imeson, Finch & Co.; Wallington and Co.; J. Baker & Co., Ltd.; W. S. Fuller; Wilson, Pearce & Co. T. Hill Jones; B.I. and Helsby Cables.

Woolwich.—The B.C. has accepted the tender of the Lancashire Dynamo and Motor Co., at £63, for a 20-H.P. motor, and has placed an order with Wellman-Seaver & Head, Ltd., at £38 10s., for switchgear.

Wimbledon.—The General Electric Co., Ltd., have just obtained a contract for the supply of Osram lamps to Wimbledon U.D.C. Electricity Department, which includes a large quantity of 200 and 300-C.P. lamps for street lighting. Successful experiments have already been carried out with high candle-power Osrams for street lighting at Wimbledon, and a large number of them have already displaced arc lamps in this neighbourhood. The General Electric Co., Ltd., have also secured a contract for the supply of Robertson lamps to the Wimbledon Electricity Supply for the forthcoming 12 months.

York.—The T.C. has accepted the tender of the Selsen Engineering Co., of London, for plant for repairing tramcars, &c., at £348.

FORTHCOMING EVENTS.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, April 5th. At 7.30 p.m. At the Grand Hotel, Manchester. Supper and smoking concert.

Faraday Society.—Tuesday, April 5th. At 8 p.m. At the I.E.E., 92, Victoria Street, S.W. Paper on "The Electrical Theory of Dyeing," by Prof. W. W. Haldane Gee.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, April 6th. Meeting at 7.30. At the University, Birmingham.

Röntgen Society.—Thursday, April 7th. At 20, Hanover Square, W. Papers on "Some Methods of Using the Alternating-Current Mains for Röntgen Ray Work," by Dr. G. B. Batten; and "Treatment of X-Ray Dermatitis by Radium," by Mr. M. Davidson.

Institution of Electrical Engineers (London).—Thursday, April 7th. At 8 p.m. At the Institution of Civil Engineers. Paper on "The Progress of Electric Braking on the Glasgow Corporation Tramways," by Mr. A. Gerrard.

Physical Society.—Friday, April 8th. At 8 p.m. At the Imperial College of Science, South Kensington, S.W. Paper on "An Experimental Demonstration of the Loading of Artificial Telephone Cables," by Mr. B. S. Cohen.

Association of Engineers-in-Charge.—Saturday, April 9th. At 6.30 p.m. At the Holborn Restaurant. Annual dinner.

NOTES.

Institution and Lecture Notes.—Railway Signal and Telegraph Engineering Institute.—Branch meetings were held at Reading and Basingstoke last month, and on the 19th ult. some of the members visited the telegraph galleries of the G.P.O. West.

Owing to the rapid progress of the movement it became necessary to call a half-year's general meeting, which was held on Wednesday last week, to review the position of the Institute and report progress. A special sub-committee has been elected to deal with the production of the *Journal* of proceedings for the benefit of all members.

American Institute of Electrical Engineers.—To-day this Institute brings to a close a three days' meeting at Charlotte, N.C., at which the following subjects have been under consideration:—

"Economics of Hydraulic Plants," by U. S. Lee.
"Electric Drive in Textile Mills," by A. Milmow.
"Calcium Cyanamide and Its Relation to Water Powers," by Chas. H. Baker.
"Gas Engines in City Railway and Light Service," by E. D. Latto, jun.
"Protective Devices for High-Tension Transmission Lines," by L. C. Nicholson.

Institution of Electrical Engineers (Manchester Section).—The annual meeting of the Manchester Local Section was held on March 22nd. Mr. J. S. Peck proposed a vote of thanks to the chairman (Mr. S. J. Watson) for his services during the session, which was duly awarded. Mr. S. L. Pearce proposed a vote of thanks to the hon. secretary and treasurer, and specially mentioned the work that Mr. Wilson had done in attending the Council meetings in London. Mr. T. L. Miller proposed that the best thanks of the Section be tendered to the Council of the University of Manchester, and Prof. Rutherford, for allowing the use of the room for holding the meetings. The annual report of the Committee was read, and showed that the membership of the Section amounted to 786, as compared with 776 last year. The following is the result of the voting for the chairman and Committee for next session:—Chairman, Mr. J. S. Peck; vice-chairman, Mr. W. Cramp; committee, Dr. F. H. Bowman, Dr. Rosenberg, Prof. Marchant, Prof. Schwartz, Messrs. C. J. Beaver, A. A. Day, A. P. M. Fleming, J. Frith, T. L. Miller, S. L. Pearce, C. D. Taite and A. P. Wood; past chairmen (*ex officio* members), Messrs. M. B Field, Miles Walker, and S. J. Watson; hon. secretary and treasurer, Mr. H. W. Wilson.

Association of Engineers-in-Charge.—The annual dinner will take place at the Holborn Restaurant, on Saturday, April 9th. The president, Mr. Henry Adams, will preside, with the Lord Mayor and the Sheriffs of the Corporation of London as the guests of the evening. Early application should be made to the hon. secretary for tickets.

Dr. Hall Edwards, who has suffered so severely through his work on X-rays, read a paper at the International Physio-Therapeutic Congress in Paris on Tuesday last, dealing with "Protection Against X-Rays." He stated that absolute protection could now be given to both operator and patient.

Institution of Municipal Engineers.—The roll of the Institution now stands at 704 members and 97 students, making a total of 801. The arrangements for the examinations have been finally settled, and the first examination will be held in London in October next.

Lift Fatality.—Peter Johannsen, Norwegian electrician, was killed at Durban on March 5th whilst attending to an electric lift at the Mercantile Club, Commercial Road. It appears that the man was working at the bottom of the lift well when the cage started up, and the counter-weights, descending, killed the man instantly. He had omitted to throw out the main switch for the lift before going into the lift well, and it is presumed that someone attempted to use the lift by pressing a push button.

Appointments Vacant.—Electricity works engineer and manager and practical electrician, for the Abertillery U.D.C. Engineering clerk of the works for the Essex and Colchester Second Asylum (£4). Traffic superintendent for the Blackpool Corporation Tramways Department (£200). Installation assistant for the Shanghai Municipal Council (£350). See advertisements in this issue.

The M.E.A. Meeting, June, 1910.—Just as we go to press we receive a copy of the preliminary programme of the annual convention of the Incorporated Municipal Electrical Association, which is to be opened at Glasgow on June 14th (Tuesday), continued at Edinburgh on June 15th and 16th, closing at Glasgow on 17th inst. The subjects for consideration are:—"Commercial Progress," by Messrs. A. C. Cramb and H. Collings Bishop; "Mixed Pressure Turbines," by Mr. A. Bremner; "Exhaust Steam Turbines," by Mr. F. A. Newington; "Chemistry in the Boiler House," by Mr. A. R. Sillar; "Advantages of Continuous Records of Costs and of Steam Consumption"; and "Cheapening of the Cost of Mains and Services." Mr. Lackie will deliver the presidential address, and an excellent series of works' visits has been arranged.

Legal.—City of Birmingham Tramways Co., Ltd., *v.* George Law.—Last week, at the Birmingham Assizes, the hearing of this case was resumed. Plaintiffs claimed for damages for negligence. It appears, from a report in the *Worcester Times*, that the action arose out of an accident on the tramway in the Bristol Road on October 4th, 1908, at a time when the line was being relaid. The cause of the accident was alleged to be a wooden sett, which had risen up to the extent of 2 or 3 in. This caught the near gear box of a car and caused it to rise and turn over.

Mr. Hugo Young said, in reference to the method adopted in moving the concrete bed, they were not obliged to do it in the most perfect way. It had to be shown that they did it, under the circumstances, in a negligent way. They contended this was not the case. They were not taking up one, but each set of rails. It stood to reason that if the line had to be relaid, it was because it was worn out. Evidence would be given that the concrete was worn out, and was not in a rigid form. It could easily be broken up, and a good deal of it was quite friable. Evidence would also be given that it was so broken up as not to disturb in any way the adjoining lines. Whilst the work was in progress it was never suggested they were doing it in an improper way. It would be further contended that the accident was not due to the risen sett, but that the car left the metals before it came to that point at all. As to damages, he submitted that defendant could not be held liable, as he had only been granted a user of the line during the period the operations were in progress.

Alfred Dickenson, who was general manager of the company 15 years ago, said he inspected the permanent way and, so far as he could see, there was nothing to account for the accident; in fact, he reported to the city surveyor that the track was in such good condition that there was no justification for relaying at that point. He saw the hole from which the sett had been removed. There was nothing in the surrounding setts to indicate that they had been injured or disturbed. The wheels used were chilled cast-iron, the flanges of which had chipped. In his opinion the accident was caused by a chipped flange biting and mounting the rail. If steel-tired wheels had been used there would have been no chipping, and, therefore, no accident; because, if the wheels had been perfect, even if the sett had caused the car to jump, the car would have kept the rails.

Edwin Kenworthy, resident engineer for the defendant during the progress of the work, said they found the bulk of the concrete worn out. It would not have been removed if it had been sound. On examining the track after the accident, he came to the conclusion that the car had left it some distance before it reached the sett, which had nothing to do with the accident.

Mr. Thomas Arnall, assistant city surveyor, said he visited the work every day while it was in progress, and he had no reason to complain of the manner in which the concrete was taken up, or the rails protected. If he had a theory at all he would say it was defective wheels.

George Law, jun., said the concrete was not taken up in a hurry, leading them to do it improperly. They were doing their best to get through the work, but not running risk in any way. His firm put the accident down to the chipped flanges of the wheels.

His Lordship reserved his decision.

Our Trade with South Africa.—Mr. R. Sothern Holland (H.M. Trade Commissioner in South Africa) is setting up at his Cape Town office a Bureau of Commercial Information. He intends that this shall render available for South African buyers full information concerning goods manufactured in the United Kingdom. It is, therefore, suggested by the Board of Trade that British manufacturers would find it useful to forward to Mr. Holland the following information, viz.: Name and address of firm; class of goods manufactured; code address and codes used; terms of payment and discounts; and name and address of South African agents, if any, together with catalogues complete (in duplicate); price lists, photographs, &c. Samples are not desired. According to the *Times*, the Bureau "is not intended in any way to supersede existing arrangements between British firms and their South African agents or independent importers. On the contrary, persons in South Africa seeking information will be advised of the names of local firms stocking the particular goods about which inquiry is made. The establishment of the Bureau and a statement of its scope and intention will be announced in the South African Press and by direct communication to South African Chambers of Commerce, Importers' and Farmers' Associations, and by other means. Communications on the subject should be addressed direct to H.M. Trade Commissioner, P.O. Box 1,346, Cape Town. Postage, plus Customs duty (2d. a lb.), on all parcels of catalogues in excess of 8 oz. must be prepaid.

Electrical Enterprise in Russia.—The *Financier* Russian correspondent writes:—The engineer Tchaieff is asking, with the support of the town of Yalta, permission to construct an electric tramway in the town of Yalta, on a 55-years' concession basis.

A contract is being made with the engineer Laskin to light the town of Hennitchesk, in the Government of Tabriz, with electricity.

A considerable extension of the electric lighting system is contemplated at Kieff.

The Government Council of Tchernigoff has decided, says the *Kieff Mysl*, on establishing a telephone system for the whole of the province.

The firm, A. Lyskin, has offered to supply the town of Orgieff with electric light over a period of 15 years on concession terms.

The *Yuzhnaya Rossia* Electricity Co.'s offer to reconstruct the Rostoff, on the Don, electric station and supply current at a reduced rate is under favourable consideration by the Town Council.

The town of Simferopol is preparing the terms of a contract with the engineer Bielein for a 40 years' electric tramways concession.

The *Tiflis Listok* says that it is intended to begin this spring with the construction of a great series of hydraulic and hydrotechnical works near the village of Atazhukino for the production of electric current, &c.

The *Dalny Okrain* says that there are only two offers for the construction of the Vladivostock Central Station; one by the firm of Varpeboldt, which offers to accept payments over a period of five years; the other by an American engineer, Yung, who is asking for a 20 years' concession.

The St. Petersburg firm of "Volt" is charged to prepare plans for a water and electric lighting system for the town of Novo Nikolaieffsk. The station will be built on the River Ob.

The Minsk Town Council is arranging to change over from horse to electric traction in the town tramways system.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—At the final meeting of the Hanley T.C., which body becomes merged into the Federated Corporation, it was recommended that the salary of Mr. C. H. Yeaman, electrical engineer, should be increased from £350 to £400 per annum. It was decided, however, by ten votes to nine, to refer the matter back to the E.L. Committee.

The Bridlington T.C. has increased the salary of Mr. Frank Crooks, chief of the electricity staff, who was recently appointed to the position, from £90 for the first year, to £100, rising by £10 per annum to £130. Mr. Crooks had received an offer of a position elsewhere at a better salary than that fixed by the T.C.

Mr. Thomas Smith, public lighting attendant to the Bridlington Corporation, has been appointed to a similar position under the Stockport Corporation.

The Battersea B.C. received 122 applications for the position of commercial assistant to the electricity department, at £2 a week with commission. Mr. C. W. Woodhead, of Finsbury Park, was appointed.

On Thursday, March 24th, Mr. E. A. Fella, mains superintendent at Croydon, was made the recipient of a case of table silver on the occasion of his approaching marriage.

Tramway Officials.—The Blackpool Tramways Committee, on March 24th, appointed Mr. C. Furness, borough electrical engineer, as manager of the Corporation tramways, at a salary of £700 per annum, an increase of £100 a year on his present salary.

General.—Mr. T. W. Storey, A.I.E.E., has resigned his seat on the board of directors of the Alliance Electrical Co., Ltd., and will in future practise as a consulting engineer. During the past 12 years Mr. Storey has been responsible for large installations of electrical plant in private mansions throughout the United Kingdom.

Mr. James T. Forgie, of Bothwell, who has been elected chairman of the Parliamentary Commission on the use of electricity in the coal mines of Britain, is the managing director for Messrs. William Baird & Co., Ltd., coalmasters, Glasgow.

Obituary.—We learn with deep regret that Mr. Percival Storey, the borough electrical engineer of Torquay, died at his residence at Torre last Friday evening, after a very long illness, at the early age of 45 years. He had been borough electrical engineer for a period of about 12 years, even since the establishment of electricity works in the town.

NEW COMPANIES REGISTERED.

Surfacing Machinery, Ltd. (108,229).—This company was registered on March 17th, with a capital of £10,000 in £1 shares (7,500 preferred), to acquire and turn to account a patent owned by G. H. Alexander and C. J. Morehouse for an invention relating to improvemets in the manufacture of electric rotary floor surfacing, scrubbing and polishing machines, &c. The subscribers (with one share each) are:—E. C. Fowke, 120, Colmore Row, Birmingham, solicitor; J. Stobie, 120, Colmore Row, Birmingham, solicitor. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, 100 shares. Registered office, 14, Lower Essex Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Holsworthy Gas and Electric Supply Co., Ltd. (107 456).—Debenture dated March 11th, 1910, to secure £1,000, and mortgage of even date, as collateral security thereto, charged on *(a)* the company's undertaking and assets, including uncalled capital, and *(b)* land and building at Holsworthy, Devon. Holder: W. Harris, Ratherton, Holsworthy.

Cleveland and Durham Electric Power, Ltd. (89,539) —Issue on March 9th, of £5,000 2nd debentures, part of a series to secure £150,000, particulars of which have already been filed.

CITY NOTES.

British Insulated and Helsby Cables, Ltd.

Mr. E. K. Muspratt presiding at the annual meeting held at Liverpool on March 21st, said that the diminution in the profit had been largely due to the smaller volume of business done by the company. Trade generally was in a depressed condition last year, and the electrical industry suffered in common with other businesses, and exceptionally so, for several reasons. In the first place, the introduction of a more economical type of lamp rendered it unnecessary for supply companies to enlarge their mains; and, secondly, to the almost total cessation in new tramway enterprises. Then, owing to the near approach of the transfer of the telephones from the National Telephone Co. to the Government, both of these buyers, who are large customers of the company in normal times, had been very sparing with their orders. These causes of shortage of business were passing away, and there were already indications that, with the improved trade of the country generally, the work to be done by this country would again increase. But for the recent expansion of the business of the company into channels not strictly coming within their special business as cable-makers, the depression would have been more severely felt. The policy of widening the basis of the company's business, was shown in the increased expenditure under the item buildings, plant, and machinery. The expenditure had provided a new factory at their Helsby works for the manufacture of motor-car tires. The extension had been fully justified by the increasing volume of this business done by the company. The facilities at the instrument works of the company at Liverpool had been greatly extended, and the company should reap the benefit of this as soon as the present interregnum in the telephone service of the country came to an end, for it followed that the arrears of work that were now accruing in this direction would have to be made up as quickly as possible at an early date. The stock and work in progress were increased by £47,791, owing to the necessity of holding stocks of the new articles manufactured, and the extension of the foreign business of the company. With regard to investments, after writing off £8,500, the balance left was £512,619, as compared with £560,496 at the commencement of the year, being a net increase of about £12,000. This increase was almost entirely due to the capital requirements of the Midland Power Co. They were largely interested in this company, owning nearly all their shares. The position of this company had very much improved during the year. The extremely depressed condition of trade in the Black Country was now passing away, and the new business booked by the Midland Co., and the revenue, showed a very satisfactory increase. There were indications that from this year onward the Midland Co. would no longer constitute so serious a responsibility to the company as in the past. With regard to the other company in which they were largely interested, he regretted to say the report of the Electric Supply Co., of Victoria, Ltd., was not so good. The business done had shown an increase during the year, but this had been counterbalanced by the increased cost of working expenses, due, chiefly, to the increased cost of fuel, owing to the strike among the miners. Upon the whole, the shareholders were to be congratulated on the results of a somewhat trying and exceptional year. Some of the new departments that had been recently started were already yielding a satisfactory return on the outlay. From others still more recently started the company had not yet reaped the benefits which the directors were confident would ultimately accrue. A careful watch was being kept upon every department of the company's business. Departmental accounts were strictly kept, and in that way any possibility of losses or leakages in trading was quickly ascertained. The volume of business booked by the company so far this year showed a decided improvement upon that of the corresponding period of last year, and, if present indications were continued, the current year should now better results than those attained during 1909.

North of Scotland Electric Light and Power Co., Ltd.

The directors' report for the year ended December 31st, 1909, tells of satisfactory progress. The gross profit, including £1 7s. 5d. brought forward from last year, is £4,108, and after meeting interest paid on debentures and loans, amounting to £1,876, and writing off £406 for loss on free wiring and motors dismantled, balance of cost of street lighting alterations and depreciation on meters, &c., there remains a net profit of £1,825. It is proposed to carry £1,600 to renewal reserve account and the balance of £225 forward. £1,004 of debenture stock has been issued during the year. Mr. F. E. Gripper offers himself for re-election as a director.

Statement of Electricity Generated, Sold, &c.

	Montrose.	Brechin.	Inverness.
Quantity generated in Board of Trade units	247,704	174,667	328,814
Quantity sold.			
Public lamps	62 461	81,441	—
Private consumers by meter	120,020	92,571	267,968
Total sold	182,481	124,012	267,968
Quantity used on works	51,277	38,644	43,471
Total quantity accounted for	233,758	162,656	311,439
Quantity not accounted for	13,946	12,011	17,405
Lamps connected January 1st	20,296	17,071	18,106
Lamps connected December 31st	20,153	17,841	21,870

Rio de Janeiro Tramway, Light and Power Co., Ltd.

In an interim report the directors state that the work of reconstruction and electrification of the company's tramway lines has steadily progressed, and is now approaching completion. The few miles which remain to be finished should be completed and in operation by the beginning of May next. The company, during last year, acquired a predominant interest in the share capital of the Jardim Botanico Tramway Co., thereby considerably strengthening its position. The greater part of the proceeds of the shares of the Rio de Janeiro Tramway, Light and Power Co., Ltd., issued in May, 1909, was applied in payment of part of the purchase price of such interest.

For the purpose of providing the funds required in connection with the construction of the new gas works and the balance of the original purchase price of the shares in the capital of the Jardim Botanico Co., and for the additional shares since acquired, and for the extensions in the underground and other installations required in connection with the new contract for street lighting and for other purposes of the company, the board of directors have decided to issue a further 62,500 shares in the capital stock, part of the unissued balance authorised by general meeting of May 3rd, 1909, and to offer the same to the shareholders at par.

Willans & Robinson, Ltd.

The directors in their report for the half-year ended December 31st, 1909, state that after writing off £4,246 as depreciation, and after paying £4,264 as interest on debenture stock, the result of the half-year's trading shows a loss of £8,282. Deducting £1,015, carried forward at June 30th, 1909, there is left £7,267 now standing to the debit of profit and loss account. It is not possible to pay any dividend on the preference shares for the half-year, or to meet the charge for interest on and redemption of the funding certificates. The total amount of the arrears of preference dividend is thus brought up to £14,999 17s., and of interest on funding certificates to £1,563. Debenture stock to the amount of £20,939 has been redeemed during the half-year out of the proceeds of the fire insurance fund. This has been purchased at a discount, and the profits on the transaction, £4,545, and interest on the remaining fire fund securities, £348, have been added to the reserve fund, bringing it up to a total of £67,522. Against this total has to be set a sum of £15,000, the cost of the lawsuit referred to in the previous report, and the directors propose that a further sum of £10,000, to meet certain outstanding liabilities, be also set against the reserve fund, reducing its amount to £42,542. In the valuation of materials and stores a special sum of £1,730 has been written off the value of obsolete or little used stock during the half-year, reducing by that amount the gross profit carried to the credit of profit and loss account. The process of special reduction in the re-valuation of stocks has been in operation for many years past, and even during the last half-year of bad trade it has not been considered desirable to suspend its operation. The state of trade throughout the year 1909 was bad. It has been impossible to secure a sufficient volume of work to keep the shops fully employed, and the prices obtainable have been unsatisfactory. Some of the recently adopted lines of manufactures are now beginning to bring in orders, and with an adequate supply of work, and the more reasonable level of prices which an improvement in trade, when it comes, will bring, should enable good profits again to be earned. Mr. J. C. Peache offers himself for re-election. It has been decided to recommend the election of Mr Frederic R. Davenport as an additional director, in accordance with the terms of the resolution to be proposed. Mr. Davenport will give the whole of his time to the service of the company, and it is intended that he shall act as assistant managing director, more especially in charge of the commercial part of the business. By the appointment of Mr. Davenport the directors expect to effect a substantial improvement in the position and operations of the business, and they consider that under these altered conditions it is desirable to leave the election of a chairman in abeyance.

Liverpool District Lighting Co., Ltd.

The annual meeting was held at Liverpool on March 23rd, Mr. Charles M'Laren presiding.

The Chairman, in moving the adoption of the report, remarked that if any of the shareholders would like a good investment they would find it in the debenture issue of the company of £6,000 at 4½ per cent., which were redeemable in three years' time. Notwithstanding the reduced consumption of electricity brought about by the use of the new metallic-filament lamps, the company had done well. They had made a profit of £3,412 after deducting all expenses. They had declared a dividend of 4 per cent., carrying forward £1,238, against £907 last year, after writing off £1,075 for depreciation and reserve. The directors had decided to take up the balance of the shares left from the last issue of February, 1907, in consequence of further capital expenditure rendered necessary at the generating station, Waterloo. In consequence of the resignation of their late manager they had appointed a successor in Mr. Hanson, who had special experience in work similar to that of the company, and they felt confident he would be a very good manager. They had decided on an improvement by dividing all the cables into sections, so that any fault that might occur would be confined to one small area, and only a few consumers would be affected. In their business there were only two raw materials, labour and fuel, and labour could not be reduced, but the same staff could deal with a very much larger business. Therefore they had only fuel to look to for further economy. There were seven small engines at the works which had been added as the business had increased; some of them were 10 years old, and required much more steam per horse-power to drive than more modern engines. They proposed to install a large engine and dynamo, which would generate electricity with about half the steam now required, and this would mean a corresponding reduction in the cost of coal. The steam after leaving the engines would be condensed, and the water used over and over again, so that £50 or £60 would be saved in a year in the mere cost of water, while there should be a large saving in oil and repairs. They would also be able to produce 100,000 more units each year for the same cost as to-day, or they could sell the same amount of electricity as to-day at a reduced cost of £400 a year. They were going to open a showroom and inquiry office at Waterloo, and they had engaged a canvasser to find new customers and keep their installation department busy. A speciality would be made of heating and cooking and motive power, and customers would shortly be able to see electricity being used for all these purposes at their showroom. They would probably arrange for special cooking demonstrations by a qualified person on one afternoon of each week. These were the lines on which they proposed to further develop the business, and though it would take some months to get thoroughly into touch with customers, they hoped next year to show a satisfactory increase in the units sold, in spite of the further reduction in lighting accounts which was bound to follow when the price of the metal-filament lamp had been reduced.

The report was adopted.

Electric Light and Power Supply Corporation, Ltd., Balmain, Australia.

The third half-yearly report of this company (to December, 1909) states that the electrical plant which was opened at Balmain in September last has conducted the lighting of the municipality entirely satisfactorily. More than 100 applications from private consumers have been received, and the continued working of the destructor plant gives satisfaction. Negotiations with the Newtown Municipal Council have resulted in an arrangement for the supply of electricity to the municipality. Negotiations are also being carried on with other adjacent municipalities for the extension of the company's operations, and these have every promise of success. Having had to buy coal at greatly enhanced prices, owing to the strike, the works costs have been considerably increased. The balance at debit of profit and loss account for the six months was £255. Of this sum £100 has been carried to formation and preliminary expenses, and £155 carried forward.

We understand from our correspondent that the above company, which began operations about two years ago, is running the Sydney Municipal Corporation close for the lighting of several of the suburbs, and has in two instances been successful. The Sydney Council, we understand, is not popular with other councils, which prefer to run their own plants in preference to depending upon one large unit in Sydney. Mr. J. E. Donoghue, the managing engineer of the company, it will be remembered, was formerly assistant city engineer.

American Telephone and Telegraph Co.—A Reuter dispatch from New York states that the stockholders have voted in favour of an increase in the capital of the concern from $300,000 000 to $500,000,000, and of raising the number of directors from 18 to 25.

Shawinigan Water and Power Co.—A dividend of 1 per cent. has been declared for the quarter ending March 31st.

Lymington Electric Light Co., Ltd.

The annual general meeting was held at the supply station on March 23rd, Mr. Keppel Pulteney presiding. The directors recommended that £830 be placed to the reserved account and a dividend at the rate of 5 per cent. per annum be paid on the preference shares, amounting to £321, leaving £8 to be carried forward. The chairman expressed regret that they were going to lose the services of Mr. Glynn Salter, their engineer and secretary. Mr. J. C. N. King, on behalf of the shareholders, proposed a hearty vote of thanks to Mr. Salter for his past services, which was seconded by Mr. G. Elliott, while Mr. W. Green expressed appreciation of the way in which the working expenses had been cut down.—In supporting, Mr. Cuthbert Wigham, said he was probably better acquainted with Mr. Salter's work than anyone, and it was because of what he knew and thought of him that he had selected him to take one of the most onerous and important positions under his firm in a large town in Scotland.—The report was adopted.

Guildford Electricity Supply Co., Ltd.

The directors report that the company during the past year has made very satisfactory progress, the gross receipts being £7,490, as compared with £6,773 for the year 1908, thus showing an increased revenue of £718. There is a balance on the revenue account of £3,293 (after crediting the depreciation fund account with £1,000), as compared with a balance of £3,168 (after crediting depreciation fund account with a like amount) on the revenue account for 1908. After making due provision for debenture interest, dividend on preference shares, and the placing of £500 to the credit of reserve fund account (being an addition of £100 on the amount placed to reserve fund account for 1908), the net revenue account shows a balance of £1,004 10s. for distribution. Out of this sum the directors recommend the payment of a dividend at the rate of 5 per cent., less tax, for the past year on the ordinary share capital of the company, which will absorb £700 10s., thereby leaving a balance of £304 to be carried forward.

Year.	No. of connections.	Total revenue.	Total costs.	Gross profit.
1907	588	£6,467	£2,534	£3,933
1908	661	6,772	2,604	4,168
1909	744	7,490	3,198	4,292

During the year 2,000 6 per cent. cumulative preference shares have been allotted and taken up. The total capital expenditure up to December 31st, 1909, amounts to £58,970, and the total capital receipts are £54,686; there is, therefore, a balance over-expended of £4,284.

	1909.	1908.
Units sold for lighting	263,822	244,204
,, power and heating	126,666	90,528
Total	390,488	334,732
H.P. of motors connected	386	346
Total number of connections..	744	661

Newcastle-on-Tyne Electric Supply Co., Ltd.

The annual meeting was held at Newcastle-on-Tyne on March 21st' Dr. J. T. Merz (chairman) presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 443), said that the horse-power connected with their system had been increased during the year to 129,219, an increase of 17,736, and, if trade improved as it was giving promise of doing, they hoped to have a larger figure next year. The net profit stood at £102,152, an increase of £29,089, including interest received. Last year he had mentioned that they might get £102,000; it appeared now as though their hopes had been realised, but they were about £7,000 short of it, for the sum mentioned in this year's accounts included interest, which he did not include in his forecast. It was only in the course of last year that they discovered that they suffered less from the engineers'strike than they had from depression in trade. There seemed to be indications that trade was improving, but, owing to the late depression and the diversion of trade from the district in consequence of the strike he had mentioned, improvement was slow. Some of the trades on the river seemed to be getting busier, but in a business like theirs they did not experience any great improvement at the first, but had to wait several months before such an improvement had any effect on their returns. They had lost during the year £18,000 simply because their existing customers had not used as much current upon the installations that the company had made in the customers' works, or that the customers had made themselves, as they did two years ago. The company had increased the business in other directions, they had more customers, and, if they had been in the same position, and had had the same percentage of consumption last year as they had two or three years ago, they would have made £42,000 more profit. That gave them an idea of how much they suffered from some disturbances. They made last year about 16s. profit on the average horse-power connected. They had always considered that about 20s. was the normal profit per horse-power connected. Their profit would have been less than 16s. if they had relied entirely on the improvement in trade. There was another factor that came into their calculations, and that was the savings. They had practised very considerable economies last year. Not only had they had to pay considerably less for their coal, but they had effected not a little economy in the consumption of it, and they further economised by, for the first time, having drawn largely for the purposes of fuel upon the waste heat and waste gases at certain collieries that had put in new plant for the making of coke. It was interesting to know that about 30,000 tons of coal were represented by the fuel they got in that form. They could take energy of that sort at any point, and put it into their general system, and effect a great saving. This meant, however, covering the whole county with a network of mains, so as to be in a position not only to supply their customers with current, but also to use these otherwise unutilised sources of fuel which existed in the County of Durham. Their cable system had been only very slightly increased, and was now 212 miles in extent. They had increased their customers by 242 during the year, which had brought the total to 5,081. The share capital remained the same as last year. The debenture capital had been converted, and they had increased it by £248,500. They had offered to convert the existing debentures—the 4 per cent. first and the 4½ per cent. second—into this new stock, and a very large proportion of holders had elected to have their stock so changed. They had put some of the £248,500 on deposit or temporary loans, and put some other into collieries in Durham, the operations of which they now partly controlled, and they had repaid cash loans to the extent of £12,444. The remaining £145,902 had been spent on plant, largely at Dunston works, and sub-stations and mains. As to the prospects for the current year, he said that he could not make so definite a statement as he had done 12 months ago, but the position was slightly better than last year. The receipts and profits up to date compared with the previous year were better—perhaps 10 per cent. better. There was one cloud hanging over them, however—namely, the unsettlement in the coal trade. So far as their supplies of coal were concerned, the directors and manager had done everything to provide for them, so that they did not expect any great calamity could happen to them, whatever came over the coal trade in that district; but if the disturbance went on, or got worse, no doubt their customers would be affected, and the demand would be affected. The directors had had under consideration the making of some provision for their staff by way of introducing a pension fund on similar lines to those which existed in connection with other large industrial undertakings. They had gone into the details of a scheme which had been drawn up in the rough. It had been agreed by the board, and was being further considered by the solicitors and some of the directors. The matter would be brought up again.

Mr. J. H. Armstrong seconded, and the report was adopted.

A dividend of 5 per cent. on the preference shares and one of 4 per cent. on the ordinary were declared. Dr. Merz, Mr. J. H. B. Noble and Sir Lindsay Wood, the retiring directors, were reappointed, and a vote of thanks terminated the proceedings.

County of Durham Electrical Power Distribution Co.

The annual meeting was held in Newcastle-on-Tyne on March 21st, Dr. J. T. Merz presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 454), said the H.P. connected was 35,024, an increase of 5,688. There had been some progress made in the lighting department, and they had sold 125,000 units more than in the year before. The revenue derived from the lighting department, £11,254, was an increase of £873. The profit was £31,111, which was £6,887 more than the previous year. The trade of the district had been very depressed, and they did not realise last year that the depression of trade in the district had been so great. They thought that when the strikes in the shipbuilding and engineering trades had been settled trade would improve; in this they were disappointed. The depression in trade had done more harm, apparently, than the strikes. They had made, however, in spite of that, a larger profit, and they had been able to keep up the depreciation to £6,000, and to pay the full preference dividend. Their extensions were now coming to an end. Referring to the new Act of Parliament that the company had got through last year, he said the object of this was to link up the different companies in such a way that they could be of mutual assistance. The result of the Act was that the companies had, *inter alia*, power to enter into agreements with the Newcastle Supply Co. and the Cleveland Electrical Power Co., its neighbours on the north and south, for mutual assistance or association with each other in the connecting of generating stations and sub-stations. This was a very important Act, and was important mainly to the Durham Co., as being situated between the two other companies. But it was also of importance to the two other companies. He could not say much as to the future, as they did not know how the trade of the district would improve in the course of this year. They had heard much of this improvement, but had not noticed it in their returns, though it took some time before the influence of such an improvement made itself felt with the company. Then the Durham Co. was more affected by the unsettlement in the coal trade than most other companies. First of all, a great number of its customers were coal-owners, and it supplied power to a large number of companies. Secondly, that portion of their business that was dependent on the general public service was very much smaller in proportion than it was in the Newcastle-on-Tyne Co. Therefore, as that trade, which was a very important factor to that company, was in a state of great uncertainty, it was impossible to make any forecast, but, in general, the costs would be considerably reduced, and thus they might hope, if trade improved, and if this unsettlement in the coal industry passed away, there would be a considerable improvement in their business.

Mr. J. H. Armstrong seconded, and the report was carried.

A dividend of 5 per cent. on the preference shares was declared. The retiring directors—the Right Hon. R. Spence Watson and Mr. J. H. Armstrong—were re-elected.

Underground Electric Railways Co. of London, Ltd.

The directors, in their report for the half-year ended December 31st, 1909, state that the result shows a substantial improvement. The net revenue from investments and properties (including general interest), after deducting general expenses, amounted to £82,360. The net income from the operation of the power house was £40,241; the interest on £775,000 4½ per cent. power house debentures to October 1st, 1909 (date of redemption) amounted to £8,719; the interest on £1,000,000 4½ per cent. first power house debentures, from October 1st to December 31st, 1909, and a proportion of commission, discount, and expenses incurred in connection with the issue, required £10,435, leaving a surplus from the power house of £21,087. The service of the £1,000,000 5 per cent. prior lien bonds required £26,458; the service of the £2,818,700 4½ per cent. bonds of 1933 required £67,120; the payment under the guarantee on Metropolitan District Railway assented extension preference stock amounted to £9,404, leaving a surplus over half-yearly charges of £466, which has been placed to a reserve which has been applied in reduction of the accumulated revenue deficiencies. The income from investments for the six months shows an increase of £25,010, or about 45 per cent. over that for the corresponding half-year of 1908. The directors have every reason to believe that the sum of £160,000 due by the estate of the late C. T. Yerkes in respect of unpaid calls on shares of the company will be paid in full, the greater part within the coming year, together with interest at the rate of 5 per cent. per annum from the date of the respective calls. On account of interest accrued to Dec. 31, 1909, the sum of £6,500 has been credited to revenue account in the last half-year. The traffic of the railway companies in which the company is interested is increasing satisfactorily (see Table below). The annual accounts of the London United Tramways Co., Ltd., have not yet been published, but the receipts have again been unsatisfactory. Sir Clifton Robinson has resigned the post of managing director, and Mr. A. H. Stanley, who is the general manager of the railways in which the Underground Co. is interested, has been appointed managing director of the Tramways Co., and it is confidently expected that this unification of management will prove of benefit to all the companies concerned. Electric power continues to be furnished to the Baker Street and Waterloo, the Great Northern, Piccadilly and Brompton, the Charing Cross, Euston and Hampstead, and the Metropolitan District Railway Companies, as well as to a section of the London United Tramways. The net output of electric energy from the power house during the half-year was 62,005,000 KW.-hours. The arrangements foreshadowed in the last report with regard to the issue of £1,000,000 4 per cent. first power house debentures and the redemption of £850,000 4½ per cent. power house debentures, and £150,000 4½ per cent. power house second debentures, have been satisfactorily carried out, and the loan of £225,000 has been paid off. The company has no floating debt. Stocks, shares and other property stand on the books at £12,032,339, and consist of stocks and shares in associated companies, consols, and lands and buildings other than power house property. The power house depreciation fund amounted at the end of the half-year to £135,036. The market value of the investments thereof shows a considerable appreciation. During the past year Messrs. James A. Blair and C. A. Spofford retired from the board, and Messrs. W. C. Burton and J. G. Metcalfe were elected in their places.

Folkestone Electricity Supply Co., Ltd.

The annual meeting of this company was held last week. Ald. Spurgen, the chairman, in moving the adoption of the report (see Electrical Review, page 480), said that there had been an increase in the expenditure for the year of £3,183, which was lower than in any previous year. It might be argued that it was either a good or a bad sign, but the directors were anxious to keep the capital charges as low as possible consistent with the efficient working. During the year 221 new consumers had been secured, and there were now 7,776 with 111,748 8-c.p. lamps, an increase of 7,758. The units sold were 1,354,879, against 131,884 in the previous year. They were looking forward to a great advance in the building trade in Folkestone, and almost every new house meant a new consumer of electric light. New shops were to be opened in the coming year, from which they were sure to derive revenue. The gross receipts showed an increase on the year of £1,300, which was very satisfactory, especially having regard to the fact that electric light companies all over the country were not doing particularly well. Their working expenses were also less, coal having cost them less by £634. They had absorbed a small private undertaking which had been run for years by Mr. Payer, and his customers had nearly all entered into an agreement to take current for three years. The installations at Hythe and Sandgate were not doing as well as they could wish, but they had made a profit. The company had suffered in consequence of the introduction of the filament lamps, nearly all the hotels and large places of business having adopted them. In this again they suffered in common with companies all over the country. He moved the adoption of the report and the payment of a dividend of 7 per cent., making 5½ per cent. for the year.

Ald. Penfold, J.P., seconded.

The Mayor (Councillor C. W. Young) pointed out that a weak point in their working was the expensive installation business, and the Chairman replied that they were bound to offer inducements to consumers at the outset. It would not be so essential in future.

The report was adopted.

Slough and Datchet Electric Supply Co., Ltd.

The directors in their report state that the capital expenditure during the year was £1,800, bringing the total up to £48,403. The equivalent of 1,149 additional lamps of 8-c.p. were connected during 1909:—

Year.	Lamps and motors connected.	Units sold.	Profit.
1907	13,072	250,248	£2,222
1908	15,231	368,778	3,161
1909	16,380	335,983	3,288

The total net profit available for distribution is £3,835. Out of this the directors purpose setting aside £750 to the depreciation fund, bringing it up to a total of £3,000. The directors recommend that out of the remaining net profit a dividend of 4 per cent., less income-tax, be declared. The mains, works, plant and machinery, have been maintained in an efficient condition out of revenue.

Passengers and Passenger Receipts Earned on the Railways and Tramways of the Associated Companies.

—	Baker Street and Waterloo.		Great Northern, Piccadilly and Brompton.		Charing Cross, Euston and Hampstead.		Metropolitan District.		London United Tramways.		Total.	
	Passengers.	Receipts.	Passengers.	Receipts.	Passengers.	Receipts.	Passengers.	Receipts.	Passengers.	Receipts.	Passengers.	Receipts.
June 30, 1907..	9,936,995	£61,501	11,953,759	£102,836	—	—	25,426,825	£202,099	27,804,517	£159,408	75,122,096	£525,844
Dec. 31, 1907..	10,664,876	66,536	13,914,779	115,008	9,881,357	£70,272	25,808,732	204,882	30,921,463	182,849	91,189,207	639,547
June 30, 1908..	12,940,801	79,869	17,446,477	142,111	12,182,689	84,648	29,626,586	229,532	28,817,473	165,475	100,963,976	701,635
Dec. 31, 1908..	13,337,126	82,493	16,990,501	137,255	13,015,363	89,717	31,503,722	243,117	30,438,446	183,469	105,285,158	733,051
June 30, 1909..	14,325,065	86,861	19,155,883	151,073	14,862,882	100,787	32,949,895	254,020	26,663,178	150,504	107,956,903	743,345
Dec. 31, 1909..	13,920,021	84,288	18,338,842	144,535	14,524,280	99,743	33,902,406	260,767	29,087,629	164,092	109,773,178	753,425
	75,122,884	£461,548	97,800,241	£792,818	64,416,551	£445,167	179,218,166	£1,394,417	173,732,706	£1,002,897	590,290,518	£4,096,847

Windsor Electrical Installation Co., Ltd.

The directors report that the capital expenditure during 1909 amounted to £343, bringing the total up to £85,112. The profit (including £547 brought forward), was £5,527. From this there have to be deducted—debenture interest £762, dividend on 5 per cent. preference shares £1,110, depreciation, renewal and reserve fund £1,000, directors' fees £350, leaving a balance available for dividend on the ordinary shares of £2,805. Out of this the directors recommend that a dividend of 4 per cent., less income-tax, be paid on the ordinary shares, and that the balance of £421 be carried forward. The total amount of depreciation charged against the year's revenue is £1,300, as in addition to the £1,000 mentioned above, the sum of £300 has been written off the value of the mains for the side street lighting. The whole of the cost of removing the street lamps, amounting to £134, has also been paid out of revenue. During the year new lamps were connected equivalent to 1,959, of 8 c.p. the total connected being 45,872 lamps. The mains, works, plant and machinery, have been maintained in an efficient condition out of revenue.

Melbourne Tramway and Omnibus Co., Ltd.—A quarterly dividend of 4½d. per share is announced.

Continental. — Austria and Hungary. — The Austrian branch of Messrs. Felten & Guilleaume is declaring a dividend at the rate of 17½ per cent., and the Hungarian branch one of 15 per cent. for the last financial year.

The Allgemeine Oesterreichische Electricitäts Gesellschaft, of Vienna, reports a net profit of 1,167,843 crowns, a decrease of 3,591 crowns as compared with the previous 12 months. A dividend at the rate of 6½ per cent. is, however, being maintained.

Switzerland.—The balance-sheet of the Société Suisse pour l'Industrie Electrique, of Bale, for the last financial year shows a net profit of £47,195, as contrasted with only £38,013 in the preceding 12 months. A dividend at the rate of 7 per cent. is being declared.

France.—The Compagnie Francaise des Procédés Thomson-Houston, of Paris, reports a net profit of £154,800 for the last financial year, as compared with only £105,855 in the preceding 12 months.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List—

Shawinigan Water and Power Co.—$500,000 additional capital stock.

Western Union Telegraph Co.—$40,000,000 4½ per cent. funding and real estate mortgage fifty-year gold bonds, due 1950, Nos. 1 to 20,000, for $1,000 each.

MARKET QUOTATIONS.

Wednesday, March 30th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£10	..
a Copper Sulphate	„	£19	..
a Lead, Nitrate	„	£26	..
a „ White Sugar	„	£23 10	..
a „ Peroxide	„	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a „ Chlorate	per lb.	8½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %) ..	„	£11	..
a „ Chlorate	per lb.	8½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	8d.	..
a „ Cyanide (basis 100 %) ..	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£75	..
b „ Wire, in ton lots ..	„	£112	..
b „ Sheet, in ton lots ..	„	£120	..
p Babbitt's metal ingots	„	£33 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7¾d.	¼d. dec.
c „ Tube (brazed)	„	9d.	¼d. dec.
c „ „ (solid drawn) ..	„	7¼d.	¼d. dec.
c „ Wire, basis	„	6¾d.	¼d. dec.
c Copper Tubes (brazed)	„	9d.	¼d. dec.
c „ „ (solid drawn	„	8¼d.	¼d. dec.
g „ Bars (best selected) ..	per ton	£71	£2 dec.
g „ Sheet	„	£71	£2 dec.
g „ Rod	„	£71	£2 dec.
c „ (Electrolytic) Bars	„	£62	..
c „ „ Sheets ..	„	£78 5	..
c „ „ Rod	„	£66 15	..
c „ „ H.C. Wire	per lb.	8d.	..
f Ebonite Rod	„	3/3	..
f „ Sheet	„	3/-	..
n German Silver Wire	„	1/6	..
h Gutta-percha, fine..	„	6/6 to 11/-	1/- inc.
h India-rubber, Para fine	„	11/3	9½d. inc.
i Iron Pig (Cleveland warrants) ..	per ton	51/8	2d. inc.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£13 7 6	2/6 dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£9 5	..
d Mica (in original cases) small ..	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large ..	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11d.	..
p „ „ rolled bars & rods	„	1/8	..
p „ „ rolled strip & sheet	„	1/8	..
o Platinum	per oz.	120/-	variable.
c Silicium Bronze Wire	per lb.	9½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£149 to £150	£6 inc.
n „ Wire, Nos. 1 to 16	per lb.	1/9½	½d. inc.
p White Anti-friction Metals:—			
"Ibis" brand	per ton	£45 to £150	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£26 15	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd
p London Phosphor Copper & Bronze Co., Ltd.
r W. F. Dennis & Co.

Electricity in Mines—Fatality.—At Linlithgow Sheriff Macleod and a jury held an inquiry concerning the death of an electric pump attendant in No 3 Pit, Blackridge, belonging to the United Collieries, Ltd. It was stated by witnesses that while deceased was travelling along the "dook" road in the pit he came in contact with a live cable and received the shock which proved fatal. Mr. J. Wilson, miners' agent, who addressed the Court, asked that the jury make a recommendation that a thoroughly competent man be employed by the colliery company to examine the cables, so as to ensure the safety of workmen. The Sheriff said the introduction of electricity below ground was a new danger for the wage-earner, and was a heavy responsibility on the Home Office, on H.M. Inspectors, and on employés, to take all reasonable care to see that these new dangers were reduced to a minimum. He had no doubt that this duty would be undertaken in the proper spirit by the authorities. A formal verdict was returned.

STOCKS AND SHARES.

Tuesday Evening.

It did not take the Stock Exchange very long to throw off the effects of the Easter holiday, and to resume the business activity which permeated most of the principal departments before the markets "broke up" for the recess. There is pronounced animation in British Railway stocks, including Undergrounds. Rubber shares are conspicuously good, and a general inclination on the part of the public to buy speculative investment securities is apparent.

New issues are being well taken. The Vera Cruz Electric 5 per cents. were over-subscribed, so the underwriters got out, and the price promptly rose to 1 premium. There was not so much demand for the North Metropolitan Tramways Second Debenture issue.

New Rubber companies continue to attract plenty of popular support. The fashion of the moment is to buy shares in the Java Rubber concerns, and in spite of the extra risk—as compared with Straits Settlement companies—attaching to the speculation, prices are being rapidly advanced. Another noticeable feature is the formation of various kinds of Trust undertakings, on the lines of the now famous Rubber Trust Company, and for these as well there seems to be a goodly measure of popular support.

The rubber boom is, without a doubt, one of the most interesting that the Stock Exchange has seen, and it may go further before it is pulled up. Long before that, the present buyers hope and expect to be out of the market, but the counsel may be offered that a purchaser should confine himself to shares in the good companies. There are "not-a-chance" concerns, there are worse than that, and the day must come when the shares will be offered in packets, so to speak. In that day the man who has bought good stuff, even at an absurdly inflated price, will be much less badly off than his brother who has put money into rank rubbish.

The maintenance of the strength in Home Railways, and the continuance of the boom in many of the leading stocks are the more surprising in view of a possibly higher Bank Rate, and the unsettlement in the political-financial area. While Consols are flat, Home Rails display pronounced strength. Metropolitans have jumped to 45, Districts to 22¼, Central Londons are steady, and City and South London a shade better. East Londons are slightly higher. It is worth noticing that the Debenture stocks are on the rise, and the "D" Debenture, which stuck at 3⅜ for many weeks, is now called 5 middle. For a mere gamble, there are plenty of things worse.

Underground Electric Railways issues are strong on the excellent nature of the report, showing that the company is able to meet its fixed charges out of profits without having recourse to the guarantee of Messrs. Speyer Bros., which has two more years to run. The 5 per cent. prior lien bonds are 103, and the incomes rose to 36 on the assumption that there is at all counts a chance of the company being able to pay something on these 6 per cent. bonds within a year or so.

London United Trams are not a bad market at 2⅛, and British Electric Tractions have been picked up quietly for people usually credited with knowing what they were about. Amongst the foreign issues, Rios are the most active, the shares, at 97½, being less eagerly inquired for than the bonds at 97¼. Mexicans keep about 133 and Sao Paulo at 150½.

The telegraph group is good, and the telephone list firm. New York Telephone new scrip remains in the neighbourhood at ⅞ premium, and the old bonds at 100½ have not recovered from their drop which they experienced upon holders hastening to sell these in order to apply for the new issue. Electric lighting shares are neglected, and the manufacturing division shows a tendency to improve, although changes in prices are few and slender.

English Engineers in Russian Works.—A special dispatch from St Petersburg to the *Financial News* states:—"For some time in many Russian industrial manufacturing works Russian engineers have been replaced by British engineers. The Society of Improvement and Development of the Russian Manufacturing Industry has now appointed a special commission to examine the reasons for such preference to Englishmen, but the opinion prevails that it is due to the insufficiency of Russian engineers."

Shipbuilding Orders at Sunderland.—The *Times* states that the prospects of the shipbuilding and engineering trades at Sunderland have been improved by the receipt of contracts for 30,000 tons of new shipping for Norwegian and French owners. "There is a healthier outlook on the Wearside generally. Large numbers of unemployed men have resumed work."

For Sale.—On April 6th Messrs. Lomax, Sons & Mills will offer for sale by auction, at Bolton, the electrical engineers' plant, stock, stores, goodwill and lease of Platt & Bleasdale (in bankruptcy). Particulars appear among our advertisements to-day.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations March 19th.	Closing Quotations March 29th.	Business done week ended March 29th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	3⅜ — 3⅞	3⅜ — 3⅞	..	..	..	Nil.
116,200	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..	4 18 0
$255,196,000	American Telephone & Telegraph, Cap. Stock ..	$100	8 %	8 %	8 %	8 %	143 —145	143 —145	..	..	..	5 10 4
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 58,001 to 78,000	$1000	4 %	4 %	4 %	4 %	94 — 96	93 — 95	..	..	—1	4 4 3
558,460	Anglo-American Telegraph	Stock	3¾%	3¾%	£3 4s.	3⅜%	59½— 61½	59½— 61½	..	..	..	6 1 0
3,220,770	Do. do. do. 5 % Pref.	Stock	6 %	6 %	6 %	6 %	102½—103½	102½—103½	103½	102⅝	..	5 16 3
3,220,770	Do. do. do. Deferred	Stock	1⅜	1 %	8/-	25/-	19⅝— 19¾	19½— 19¾	19⅝	19⅛	— ⅛	6 9 10
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	99½—101½	99½—101½	..	..	..	4 18 6
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 — 8½	8⅛— 8⅜	..	..	+⅛	4 16 3
2,449,176	Commercial Cable, Sling. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	87½— 89½	87⅞— 89½	..	..	..	4 9 5
16,000	Cuba Telegraph	10	5 %	6 %	6 %	..	8½— 9½	8½— 9½	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17 — 18	..	..	..	5 11 1
13,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3½— 3⅝	3½— 3⅝	..	..	..	5 3 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8 — 8½	8 — 8½	..	..	..	6 5 0
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
60,710‡	Direct United States Cable	20	4½%	4½%	4½%	..	13⅞— 14⅜	13⅞— 14⅜	14⅛	..	..	5 16 3
48,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	136 —139	136½—139½	138½	136½	+ ½	5 0 4
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	86 — 88	86 — 88	86½	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	102½—104½	102½—104½	..	..	..	3 16 7
800,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	..	12⅞— 13⅜	13 — 13⅜	..	..	..	5 4 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100½—102½	100½—102½	100½	..	..	3 18 1
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	..	10½— 11	10½— 11	10⅞	10½	..	5 4 7
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13⅛— 13⅜	13⅛— 13⅜	13⅜	13⅛	..	4 7 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	30 %	30 %	18 %	..	30½— 31½	29⅝— 30½	..	..	— ½	5 17 1
14,800	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,300, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	..	53½— 55½	54 — 56	55½	55⅜	+ ⅛	5 16 1
$41,880,400	Mackay Companies Common	$100	3⅜%	4 %	4 %	4½%	91 — 93 xd	91 — 93	..	..	..	4 11 5
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	78 — 80 xd	80 — 84	..	..	+3	4 15 8
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	2⅛—2⅜	⅜— ½	14/6	13/6	—⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	⅞— 1	⅞— 1	..	..	..	6 0 0
96,492	Do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	⅞— 1	⅞— 1	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104½—106	104½—106	105⅛	104½	..	5 13 2
2,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	123½—125½	123½—125½	125	124	..	4 15 7
15,000	Do. do. 5 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10⅝— 10⅞	10⅝— 10⅞	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	5 7/16	..	4 8 11
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98 —100	98 —100	100	..	..	3 10 0
1,988,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100½	..	..	3 18 5
179,818	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	8 %	8 %	..	1¼— 1⅜	1⅜— 1⅜	28/1⅛	..	..	5 6 1
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 7/16— 1 7/16	1 7/16— 1 7/16	25/7½	..	..	4 14 9
195,955	Do. do. do. 4 % Red. Deb. Stock ..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	87½	..	..	4 10 11
29,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
11,839	Reuter's	8	5 %	5 %	5 %	..	7⅞— 8¼	7⅞— 8¼	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
3,042	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	131 —134	131 —134	..	..	..	4 9 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7⅞— 7 7/16	7 7/16— 7 7/16	7⅞	..	..	5 7 9
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..	4 18 11
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1⅜— 1⅝	1⅜— 1⅝	30/-	..	..	3 16 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	..	13⅜— 14⅛	13⅜— 14⅛	14⅛	13⅜	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	101	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅛— ⅜	⅛— ⅜	17/6	..	..	Nil
84,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	..	8½— 9½	8½— 9½	9	..	..	6 9 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	..	8½— 9½	8½— 9½	..	..	..	6 9 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —103	100½—102½	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1st Pref., 1 to 640,000	5	..	..	..	5 %	4 7/16— 4 13/16	4⅝ — 4⅞	95/-	91/3	+ 1/16	5 2 7
500,000	Do. 5 % 2nd Pref., 800,001 to 1,800,000	5	..	..	..	5 %	4¼— 4½	4¼— 4½	92/6	88/9	+ ½	5 5 3
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	90 — 91½	90 — 91½	90¾	90½	..	4 7 5
882,887	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —106	104 —106	104	..	..	4 14 4
580,000	Babcock & Wilcox, 1 to 580,000..	1	20 %	20 %	20 %	..	5⅛— 5 3/16	5 — 5⅛	5⅛	5	+ 1/16	3 19 2
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 7/16— 1 7/16	1 7/16— 1 7/16	..	..	..	3 19 2
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	Nil	..	⅜— ⅝	⅜— ⅝	7/6	..	..	Nil
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	3½%	..	1 — 1⅛	1 — 1⅛	..	..	..	..
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	..	2⅛— 3⅛	2⅛— 3⅛	..	..	..	..
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	2 %	..	⅜— ⅝	⅜— ⅝	..	..	..	..
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	5½%	5½%	5½%	5½%	95 — 98	95 — 98	..	..	..	..
600,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	8 %	8 %	8 %	145 —149	145 —149	148½	..	..	5 7 5
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	122 —126	122 —126	125	124½	..	4 15 3
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	110½—112½	110½—112½	112	110½	..	4 8 11
335,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250 ..	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
312,600	Do. 4½ % Vancouver Power Debs., 1 to 2,900	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
135,801	British Electric Traction	10	Nil	Nil	Nil	..	1 — 1⅛	1 — 1⅛	25/9	21 10½	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	8 %	1½%	..	2⅜— 3⅜	3 — 3⅜	63/9	61/3	+ ⅛	4 5 9
1,475,658	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	..	90 — 93	90 — 93	93	91½	..	5 7 6
526,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	..	68 — 73	68 — 73	..	..	..	6 6 8
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	7⅝— 7⅞	7⅞— 7⅞	7 11/16	..	..	6 7 0
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6⅝— 6⅞	6⅝— 6⅞	..	..	..	4 10 7
500,000	Do. do. 4½ % 1st Mort. Deb. Red... ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
804,940‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	87 — 92	90 — 94	..	..	+2½	4 15 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	..	..	..	Nil
1,816,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	47 — 51	47 — 51	48½	48	..	7 16 10
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	⅛— ¼	⅛— ¼	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 106,781 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
135,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	39 — 44	39 — 44	..	..	..	10 4 6
135,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	25 — 29	25 — 29	..	..	..	15 3 0
187,610	Calcutta Trams, 1 to 187,610	5	8 %	6 %	4½%	..	4 — 4½	4¼— 4⅜	..	..	+ ⅛	4 14 9
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	5 %	5 %	5 %	5 %	4½— 5	4½— 5	96/8	..	..	5 0 0
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	..	10½— 11	10½— 11	10⅝	..	..	6 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5½	5⅛— 5½	..	..	..	4 10 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102½—104½	102½—104½	103	..	..	4 6 2
491,223	Cape E. Trams., 1 to 491,223	1	Nil	Nil	Nil	..	⅛— ⅜	⅛— ⅜	..	..	..	Nil
450,000	Casner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	..	2⅜— 2½	2⅜— 2½	..	..	..	5 0 0
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	104 —107	104 —107	..	..	..	4 4 1
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	70 — 72	70 — 72	71½	70½	..	4 3 4
554,555	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 13 0
554,555	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	52 — 54	52 — 54	53½	..	..	3 14 1
1,480,000	City and South London Railway	Stock	2½%	2½%	1½%	1½%	31 — 32	31 — 32	31½	31	..	5 9 5
85,000	Crompton & Co., Nos. 1 to 85,000	1	5 %	5 %	Nil	..	⅜— ⅞	⅜— ⅞	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909	Closing Quotations March 19th.	Closing Quotations March 29th.	Business done week ended Mar. 29th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
250,000	Dick, Kerr & Co., 1 to 250,000	1	10 %	10 %	6 %	..	⅞ — 1	⅞ — 1	..	..	..	6 0 0
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	5 9 1
271,080	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	4½ %	2½ %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½ %	2½ %	Nil	..	1 — 1 1/8	1 — 1 1/8	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	65 — 70	65 — 70	..	..	..	5 14 4
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	81 — 84	81 — 84	..	..	..	5 19 1
112,100	Electric Construction, 1 to 112,100	1	Nil	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	1	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	21/3	..	..	10 4 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7 7/8 — 8 1/4	7 7/8 — 8 1/4	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	83 — 87	84 — 88	..	..	+1	4 10 11
75,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 75,000	10	4 %	¾ %	Nil	..	⅜ — ⅝	⅜ — ⅝	13/9	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	..	..	10 — 10⅜	10⅛ — 10⅜	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103½	102 — 103⅛	..	..	— 1/8	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15 %	12⅜ — 13⅜ xd	12⅜ — 13⅜ xd	13 1/4	13 1/16	..	5 18 6
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	6 — 6⅜	5 — 6⅜ xd	5 3/32	..	..	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	105½ —107½	105½ —107½	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	15⅞ — 16	15⅞ — 16	15⅞	15⅛	..	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	¾ %	Nil	Nil	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	4⅜ — 5½	4⅜ — 5½	..	..	..	9 10 6
600,070	London United Trams. (1901), 1 to 50,007	10	3 %	3 %	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
599,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3½ %	..	2⅜ — 3⅛	2⅜ — 3⅛	62/6	56/3	..	11 10 10
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	..	4 %	4 %	70 — 73	70 — 73	72¼	..	..	5 9 7
5,782,062	Metropolitan Consolidated	100	1 %	¾ %	¾ %	1 %	43⅜ — 44⅛	44⅛ — 44⅜	44⅜	44⅛	+ 1/16	2 4 8
2,640,914	Do. Surplus Lands	100	22½ %	22½ %	22½ %	22½ %	68 — 70	68 — 70	69⅛	68½	..	3 18 7
2,285,000	Do. District	100	Nil	Nil	Nil	Nil	20⅜ — 21	21⅜ — 22⅛	22	20 1/16	+1⅛	Nil
891,337	Metropolitan Electric Trams., Ord.	1	..	..	4½ %	..	⅝ — ¾	⅝ — ¾	..	..	..	6 10 11
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	— 1/32	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	14/4½	..	..	6 3 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½ %	4½ %	4½ %	4½ %	96 — 99	96 — 99	97⅛	96	..	4 10 11
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	133 —135	132 —134	133¼	..	—1	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	5 %	..	94½ — 95½	94⅛ — 95⅛	95⅝	94½	— ⅛	5 4 9
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	84 — 87	84 — 87	..	..	..	5 3 6
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	15 %	17½ %	34 — 35½ xd	34 — 35½ xd	35½	34	..	5 16 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5% Prior Lien	..	..	..	5 %	..	102 —103	102 —103	..	..	..	4 17 1
2,800,000	Do. do. 4½% Bonds	..	..	..	4½%	4½%	89 — 91	89 — 91	90½	89	..	4 18 4
4,900,000	Do. do. 6% Income Bonds	..	..	..	..	..	35 — 37	35 — 37	36⅜	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	..
66,666	Do. 6 % C.P., 80,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1½ — 2½	1½ — 2½	..	..	..	1 4 2
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	68 — 73	68 — 73	..	..	..	5 9 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	..	4½ — 4⅝	4½ — 4⅝	..	..	..	5 15 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	91 — 94	91 — 94	..	..	..	4 18 9
30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	7⅜ — 8⅛	7⅜ — 8⅛	7 1/16	..	..	6 1 3
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	4 4 10
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	101¼	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 — 4½ xd	4 — 4½ xd	86/10½	83/1½	..	5 11 1
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4⅛	4⅛ — 4⅜	..	..	+ 1/8	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	8⅞ — 4⅜	8⅞ — 4⅜	..	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96½ — 98½	96⅝ — 98⅝	..	..	..	4 1 3
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	3½ — 4 xd	3⅝ — 4 xd	..	..	..	5 12 6
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11⅞ — 12⅜	11⅞ — 12⅜	12⅝	12⅛	..	5 13 2
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	12⅝	12⅜	..	4 10 7
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	121 —125	121 —125	124	..	..	4 0 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1½ — 2	1½ — 2	..	..	..	5 0 0
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅜ — 3⅜	2⅜ — 3⅜	..	..	..	7 8 2
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94 — 96	94 — 96	..	..	..	5 4 2
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	6 %	7⅜ — 8⅛ xd	7⅝ — 8⅛ xd	7⅞	..	..	6 3 1
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11 xd	10⅝ — 11⅛ xd	11	10⅝	..	5 7 10
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	103 —106	103 —106	105½	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	100 —103	102	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	6 %	Nil	Nil	..	1 — 1½	1½ — 1½	32/6	..	..	Nil
420,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	71 — 74	71 — 74	..	..	..	6 1 7
$8,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	5 %	5 %	80 — 83	80 — 83	81⅜	..	..	6 0 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	7 — 7½	7 — 7½	..	..	..	5 13 4
$1,876,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	102½—104½	102½—104½	..	..	..	4 15 8
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	7 — 7⅜ xd	7 — 7⅜ xd	..	..	..	5 6 8
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94½ — 96½	94½ — 96½	..	..	..	4 2 11
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2½%	3 %	..	1⅝ — 2 xd	1⅝ — 2 xd	..	..	..	4 8 11
70,000	Do. do. do 6 % Pref.	5	6 %	6 %	6 %	..	4⅜ — 5⅜ xd	4⅜ — 5⅜ xd	..	..	..	5 11 8
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4½%	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	4 — 4⅛ xd	4 — 4⅛ xd	86/10½	85/-	..	5 11 1
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	..	..	..	4 10 0
285,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
248,000	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	83 — 86	83 — 86	..	..	..	4 1 5
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	..	85 — 86	84½ — 85½	85⅞	84⅞	..	5 16 3
18,585,000	Do. Light and Power Co., Ltd., Common	$100	..	..	3½%	..	81 — 83	81½ — 83½	82½	81	+ ½	4 3 10
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	104 —106	104 —106	104½	..	..	6 12 1
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	90½ — 91¼	90 — 91	90⅝	90½	— ½	5 9 11
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96½ — 98½	96½ — 98½	..	..	..	4 11 5
120,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	4⅜ — 5	4⅜ — 5	..	..	..	2 10 0
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ — 5	4⅜ — 5	..	..	..	5 0 0
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	5 %	99 — 101	99 —101	..	..	..	4 19 0
10,853	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	11⅜ — 12⅜ xd	11⅝ — 12⅜ xd	11⅝	..	..	5 9 10
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6½ — 6¾ xd	6½ — 6¾ xd	..	..	..	5 3 8
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507	1	2½%	2 %	2 %	..	1⅜ — 2⅛	1⅜ — 2⅛	40/6	39/6	..	3 17 7
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	28/3	..	..	4 16 0
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102½—104½	102½—104½	..	..	..	4 15 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	8½ — 9	8½ — 9	8 11/16	8 3/16	..	5 10 4
80,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 16 7
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	83½ — 87	84 — 88	..	..	+1	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1⅜ — 2⅜	1⅜ — 2⅜	..	..	..	Nil
55,000	South London Electric Supply, Ord.	4	8 %	4 %	5 %	5 %	2½ — 2⅝ xd	2⅝ — 3 xd	..	..	+ ½	6 13 4
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	102½	102½	..	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	⅞ — 1	⅞ — 1	..	..	..	4 8 11
142,988	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8 xd	1 1/16 — 1 1/8 xd	..	..	..	5 17 11
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..	25 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	10 10 6
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	78 — 82	78 — 82	..	..	..	5 9 9
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	5 %	⅞ — ⅞	⅞ — ⅞	..	..	— 1/16	5 14 3
100,00	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	8½ — 9	8½ — 9	8 11/16	8⅝	..	5 11 1
51,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	4⅜ — 5⅛	4⅜ — 5⅛	5 1/16	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent., March 17th, 1910.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1910.

The February export returns generally show the effect of a short month, and although the present export returns, totalling £291,973, are apparently a considerable advance on those of the previous month and quite up to the 1909 average, they contain a considerable telegraphic export (£73,810), and the total for general business amounts to only £218,163.

The imports for the month total £153,583, showing a slight improvement on the previous month, while the re-exports show a decided improvement over anything recorded during the past two years, and total £24,630.

Of the individual export items, in addition to the telegraphic exports, mentioned previously, machinery, cable and telephonic exports are well represented, Brazil (with £41,000 worth of telegraphic goods), Argentina, India and Canada being the most prominent in the list of purchasers.

The import section calls for no particular comment; during the month £48,000 of lamps entered this country, principally from Germany, from whom we received altogether £103,378 worth of electrical goods.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	28	1,702	...	81	112	3,380	408	117	...	245	1,467	7,540
Germany and German West Africa	268	190	8	23	396	1,377	...	...	...	39	107	2,408
Netherlands	267	797	11	54	7	309	9	7	...	...	...	1,461
Belgium	151	166	6	125	1,712	1,517	...	38	...	505	...	4,220
France	808	...	392	246	24	662	...	104	...	...	23	2,259
Portugal and Portuguese India	50	...	...	50	10	1,568	...	10	...	66	32	1,786
Spain and Canary Isles	174	23	95	418	...	2,328	30	...	48	...	105	3,221
Italy, Austria-Hungary and Switzerland ...	232	...	41	254	942	1,510	...	...	...	31	21	2,031
Greece and Turkey	55	47	...	...	...	55	...	18	...	35	146	359
Channel Isles, Gibraltar, Cyprus and Malta...	38	10	33	101	10	224	...	5	...	4	...	425
U.S.A., Philippines and Cuba...	20	...	...	102	5	174	...	46	933	...	4,404	5,684
Canada and Newfoundland	116	423	1,052	2,397	202	762	615	111	...	9	17,659	23,346
British West Indies and British Guiana ...	34	...	18	57	...	71	...	...	...	...	17	197
Mexico, Colombia, Ecuador, San Salvador and Panama	...	21	...	...	...	2,036	...	...	...	82	147	2,286
Peru, Bolivia and Uruguay	15	184	...	164	...	627	18	3	...	...	77	1,088
Chile	269	59	212	9	...	218	...	46	21	175	...	1,009
Brazil	621	156	144	92	26	6,293	300	224	14	18	41,167	49,055
Argentina	1,989	12,654	283	1,218	408	12,115	1,344	556	165	1,160	709	32,601
Egypt, Tunis and Persia	55	235	279	127	8	334	9	83	...	1,096	182	2,408
British West Africa	32	118	33	36	21	15	...	5	12	...	48	320
Rhodesia, O.R.C. and Transvaal	2,638	736	62	738	...	9,377	46	61	...	679	2,804	17,141
Cape of Good Hope	1,062	1,482	138	150	175	759	4	58	...	166	352	4,286
Natal	284	10,804	...	184	139	3,485	7	64	60	23	371	15,421
Zanzibar, Brit. E. Africa, Mauritius and Aden	71	125	96	102	...	38	3	7	...	3	223	668
Azores, Madeira and Portuguese Africa ...	304	828	53	...	...	107	35	2	...	...	127	1,456
China and Siam	615	5,611	242	1,192	269	3,590	518	69	192	...	765	13,063
Japan	290	179	16	...	1,951	7,695	118	4	...	1,658	281	12,192
Java and Dutch Indies...	130	27	...	...	...	454	...	...	...	5	..	616
India	2,266	5,267	2,224	1,565	1,399	8,419	640	4,497	330	598	249	27,454
Ceylon	170	108	124	95	5	76	503	31	...	9	140	1,261
Straits Settlements, Fed. Malay States, Brit. North Borneo and Sarawak...	141	506	278	50	16	1,164	...	51	...	331	1,666	4,103
Hong Kong	1,440	580	80	531	21	388	166	402	18	...	...	3,626
West Australia	299	208	13	107	...	553	...	68	...	12	...	1,260
South Australia...	43	216	38	257	74	3,287	1,477	44	...	98	...	5,534
Victoria	783	4,174	81	532	122	422	140	369	78	599	...	7,300
New South Wales	1,734	2,936	38	942	4	9,065	...	209	57	2,418	...	17,403
Queensland	34	235	141	302	206	3,241	...	49	...	42	...	4,250
Tasmania	17	93	...	55	...	1,737	...	40	...	2,686	...	4,628
New Zealand	480	2,498	319	489	138	887	230	10	81	944	521	6,597
Total, £	18,023	53,398	6,560	12,845	8,402	89,322	6,620	7,308	2,009	13,676	73,810	291,973

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Norway, Sweden and Denmark	...	...	...	52	8	1,269	...	723	63	10,103	12,218
Germany...	747	6,833	1,794	42,119	2,202	27,592	170	1,102	6,790	14,029	103,378
Holland	2	55	...	2,176	8	86	...	...	35	10	2,372
Belgium	549	657	...	22	47	552	...	145	301	3,558	5,831
France	65	77	797	875	117	86	...	579	2,475	1,464	6,535
Switzerland	12	46	...	852	112	196	...	13	14	102	1,347
Italy	...	4,118	...	...	...	...	...	...	...	324	4,442
Austria-Hungary	...	330	...	422	...	211	...	16	1,667	134	2,780
United States	3,307	104	531	1,222	18	5,406	3,323	144	42	549	14,646
Total, £	4,682	12,220	3,122	47,740	2,512	35,398	3,493	2,722	11,387	30,273	153,549

Additional imports: Spain, carbons, £14; Canada, electrical machinery, £20.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	
Various countries, mainly as above	2,685	458	...	3,173	...	5,885	...	115	440	11,874	...

Total Exports: £291,973. Total Re-Exports: £24,630. Total Imports: £153,583.

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

PROCEEDINGS OF INSTITUTIONS.

Short-Circuiting of Large Electric Generators and the Resulting Forces on Armature Windings.

By Miles Walker, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *Manchester, March 8th, and London, March 17th*, 1910.)

(*Concluded from page* 495.)

It is probable that when we come to build machines of much larger output and of few poles, we will be compelled (in addition to providing the strongest clamps possible) to restrict the short-circuit current, by keeping down the ampere-turns in the field magnet, or by artificially keeping up the value of the self-induction of the winding. It is possible to keep down the ratio of field ampere-turns to armature ampere-turns, and yet secure extremely good regulation by adopting a suitable distribution of material in the machine.

In order to increase the self-induction of the winding we may employ choke coils in series, or we may increase the armature leak-

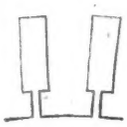


Fig. 21.—Armature Slot made with very Broad Lips in Order to Increase the Leakage and Lessen the Short-Circuit Current.

age by employing slots with semi-closed mouths and very deep lips, as illustrated in fig. 21.

In designing the winding for a turbo-alternator, the following considerations must be kept in view:—

1. The insulation is of the first importance, and nothing must be introduced which will cause a surface creepage, even after the winding has become dirty.
2. There must be plenty of space left for the circulation of air.
3. The conductors themselves must be sufficiently stiff to resist the forces which come into play between clamps.
4. The clamps must be sufficiently close together, and sufficiently rigid to resist the enormous forces which come into play on short-circuit.
5. It is desirable, if possible, to arrange the coils so that one can be taken out without disturbing the rest of the winding.
6. Where the machine is such a size that the forces on the coils would be so great as to endanger the windings, some device must be introduced to limit the current in case of an accidental short-circuit.

Direct-Current Generators.

When a direct-current generator running at full voltage is short-circuited at its terminals, the current at first may reach an enormous value, but as the poles become weakened by the cross-magnetising effect, the current falls. This is particularly so in the case of a shunt-wound generator. A series-wound generator can be made with very low saturation and a strong series winding which would maintain an enormous current until it pulled up the prime mover. In most series-wound generators saturation sets in comparatively early, and the cross-magnetisation and the resulting saturation of the armature teeth cuts down the voltage to a low figure after 12 or 15 times full-load current is reached. The first rush of current, however, is limited only by the self-induction and resistance of the circuit, just as in the case of an alternate-current generator, and it may reach 30 or 40 times full-load value.

The harm done by currents in the case of direct-current machines has mostly been confined to the breaking of shafts, the leaping of cables from their supports, in the flashing over and burning of the brushes and commutator, and in the breaking down of insulation in the various parts of the system. It is not often that the armature winding is injured, because the current is divided up between a number of parallel paths and the armature coils in the end windings lie close against one another, and cannot be moved very far by the attractions and repulsions which occur.

The twisting-off of the shaft was a common accident in the early days of traction generators. The modern practice of bolting the fly-wheel direct to the armature, and special designing of the shaft to stand a short circuit has reduced the number of accidents of this kind.

The leaping of cables is familiar to all old dynamo testers, and should always be seriously considered as one of the things which may happen in the case of a short circuit.

One case occurred within the experience of the author on a short circuit of a 500-kw. 500-volt direct-current generator. The current from the machine was carried by two lead-covered cables, 2 in. outside diameter, weighing about 8 lb. per foot. The current went out along one cable and returned by the other. The cables were laid on a shelf in a subway about 6 in. apart. When the short circuit occurred, the cables repelled one another with such great force that they flew apart and struck the walls of the subway on each side, one cable being thrown to the floor the whole length of the subway. It would probably take an initial force of 40 lb. per foot run to give such a great acceleration of the cables. Now the full-load current of 1,000 amperes would only produce a force of 0·09 lb. per foot run between the cables. It would take 20 times full-load current to produce a force of 36 lb. per foot run.

Sometimes cables irregularly coiled on the test-plate will, under the action of these enormous currents (and possibly also from the action of opposing currents induced in the test-plate), spring up into the air like snakes, and may easily lead to other accidents.

Flashing over between the brushes on direct-current generators and rotary converters in the event of a short circuit seems to be due to two causes, either of which may be the predominating factor in any particular case. One case is the failure of the machine to commutate the excessive load, and the other is the rise of pressure which occurs when the circuit breaker opens.

If a machine fails to commutate, the arc between the commutator bars and brushes becomes drawn out as the commutator revolves, until it creates an arc between positive and negative brush-holders. Sometimes a spark under the brushes still keeps alight as a spark between commutator bars, and when the bars moving away from the neutral-point have a fairly large voltage between them, these sparks grow into big arcs which combine together and form a single arc extending from brush to brush. This short circuits the field windings, and the voltage dropping, the arc most commonly goes out without doing more injury than pitting the brush-holders and the commutator.

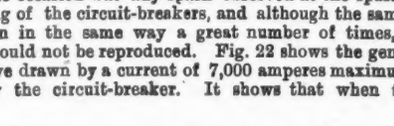
The opening of a circuit-breaker carrying a heavy current is accompanied by a rise of pressure due to the self-induction of the series windings or the self-induction of the cables. The effect is sometimes made worse by the peculiar properties of the arc which occurs on the circuit-breaker. Steinmetz has shown that when the capacity and self-induction of the circuit in series with an open arc in air have certain values, the rise in pressure may be measured in thousands of volts. Cases are not uncommon where on a 500-volt circuit the opening of the breaker has caused a discharge to occur through an air-space showing a rise of pressure of from 10,000 to 20,000 volts. In one case within the experience of the author, a 500-volt direct-current generator, when a short circuit was interrupted by the breaker, flashed over from the series coils to the frame through a distance of $\frac{3}{8}$ in. In another case, the circuit-breaker on one of the feeders supplying the North-Eastern Railway opened on a short circuit occurring on the line, and the self-interrupting property of the arc in air, of which Steinmetz speaks, was so effectual and sudden that the current in the feeder arced across from a stud on the back of the switchboard through a distance of 4 in. over a dry marble surface.

The Underground Electric Railways of London kindly put at the disposal of the British Westinghouse Co. an 800-kw. 600-volt rotary converter in Baker Street sub-station for the purpose of

Fig. 22.—Oscillograph Record of Current in Line and Voltage across Breaker when an 800-kw. Rotary is Short-circuited through a Low Resistance.

experimenting on this phenomenon. A Duddell oscillograph was used with a cinematograph film running at a speed of 25 in. per second. Adjustable spark-gaps were placed across the circuit-breaker, series winding of the converter, &c.

A great number of experiments were made. At 2,750 amperes, 5,800 amperes and 8,000 amperes, nothing remarkable happened; on only one occasion was any spark observed at the spark-gaps on the opening of the circuit-breakers, and although the same current was broken in the same way a great number of times, the phenomenon could not be reproduced. Fig. 22 shows the general form of the curve drawn by a current of 7,000 amperes maximum as it is broken by the circuit-breaker. It shows that when the knife



Current scale, 1 in. = 25,000 amperes; volt scale, 1 in. = 1,750 volts
time scale, 25 in. = 1 sec.

Fig. 23.—Oscillograph Record of Current in Line and Voltage across Breaker when an 800-kw. Rotary is Short-circuited through a Short Length of Feeder.

switches were closed the current rose so quickly that in $\frac{1}{1000}$ of a second it had reached 3,000 amperes, and in 0·008 of a second it had reached substantially its full value of 7,000 amperes. It remained almost constant for about $\frac{1}{10}$ of a second, and then as the circuit-breaker opened it was gradually reduced to zero. The whole time from the closing of the knife switches to final breaking was only 0·14 second. The voltage curve V_b gives the pressure across the circuit-breaker; the scale is too small to see any rise in voltage until just as the current dies to zero, when there is a rise which is roughly estimated at 300 volts.

The most interesting curves were obtained when the rotary was short-circuited through 270 ft. of feeder cable, consisting

of 61/12 S.W.G. wires. Fig. 23 is a diagram for this experiment; the maximum current reached was 14,000 amperes. As in fig. 22, the current rises very suddenly. The small vibrations at the beginning of the curve correspond to the frequency of the slots in the rotary converter, and are probably caused by the sparking on the rotary, which would probably have a frequency corresponding in some measure to the frequency of the rotary slots. The way in which the current falls to 10,000 amperes after attaining its maximum, and then rises again in jerks to 14,000 amperes, is rather remarkable. These fluctuations are probably due to commutating conditions controlling the length of arc on the commutator, in that way affecting the voltage. It will be seen that the current crosses zero and goes to a negative value, the maximum of which is beyond the margin of the film. It then crosses zero again and goes to a positive value of 250 amperes. It then goes negative again, forming an oscillation which has a frequency of about 0·0016 of a second. It then goes negative and after certain fluctuations falls to zero.

This oscillation of the arc is extremely interesting, and it is conceivable that with certain values of self-induction and capacity in the circuit, combined with the blowing-out action of the air arc which Steinmetz has described, it might give rise to very high rises of pressure on the circuit-breaker.

It will be seen from curve v_b that the voltage rise on the circuit-breaker is not more than 500 volts. There is, however, an oscillation of voltage which is exactly timed with the oscillation of the current.

Although the rotary was short-circuited on this short feeder a number of times in succession, the spark-gaps were not broken down. If these experiments are reproduced again, means will be provided of changing the self-induction and capacity in series with the rotary.

The experiments show that unless these quantities have such a value as to give to the circuit a natural period of vibration which is in some way related to the peculiar operation of the arc, no serious rise of pressure occurs, even when a very large current is broken.

Discussion at Manchester.

Mr. M. B. Field said no doubt there were numerous persons who could give experiences of cable jumping out of conduits, and busbars being bent up so as to look like macaroni. It was interesting to consider where the destructive energy came from, as it did not necessarily come from the turbo. The author had divided this energy into two components, an alternating-current component, and a continuous-current component, and evidently the latter was already stored in a magnetic state in the alternator and had to be dissipated in some way or other. The total energy stored up in a magnetic state in the alternator would come out at a good many foot-tons. In 1903, whilst engaged in making oscillograph tests on inductive circuits, he was considerably puzzled on obtaining some very irregular curves as the result of placing a transformer in the circuit in order to vary the self-induction. This irregularity was found to be due entirely to the capacity of the windings of the transformer.

Mr. W. Cramp said that there was very little difference between short-circuiting a generator and applying an E.M.F. suddenly to an inductive circuit. In the latter case expressions were obtained similar to those found in the paper, and it would probably be found that the maximum possible current which could flow when the worst conditions were considered, and with a circuit of constant permeability, was about twice the normal current of the circuit. The author had spoken of 10 times the normal short-circuit current, from which it followed that the great rush was due to the varying permeability accounted for by eddy currents, and the fact that the field magnets revolved in front of the coils. He asked whether putting extra self-induction in circuit, far from actually decreasing the current rush, might not in certain cases even tend to increase it. Frequency would have a great effect; the higher the frequency, the greater would be the initial rush of current. It would be of interest if the author would explain the reason why the initial rush was thought to be smaller with higher frequencies. The effect of the other two phases which were at the same time short-circuited appeared to have been left out of the paper altogether; would not the three phases when short-circuited produce a single synchronously rotating reaction, with the field due to the exponential current (if such a term might be employed) superposed thereon?

Prof. E. W. Marchant said the effect of armature reaction proper had no time to penetrate into the rotor at the first instant of short circuit, because of the eddy currents induced in the rotor core. Some time ago Mr. Catterson-Smith and the speaker made some tests on two 2,000-KW. turbo-alternators at Liverpool, the object of the experiments being to investigate the triple-frequency currents that flowed through these machines when connected in parallel. The machines were star-wound, and were rated at 200 amperes per phase, and the triple-frequency current was nearly 60 amperes in the neutral line between the machines. The triple-frequency currents balanced each other as far as armature reaction was concerned. Calculations were made by analysing the potential difference wave, so as to determine the magnitude of the triple-frequency component of the potential difference, and the result gave a value for the self-induction per phase of ·0037 henry, or a reactance of 1·17 ohms. The generators were wound for a line pressure of 6,000 volts, and the short-circuit current would, therefore, be 2,960 amperes, or approximately 15 times the full-load current. The results corresponded fairly closely with the figures given by the author. The author had mentioned that it took about one second before the current in the main exciting circuit fell from 70 to 20 amperes, due to armature reaction. With large masses of iron the time taken for any change in the state of magnetisation to penetrate was very much longer than was generally believed.

Mr. G. W. Worrall said the variation observable in the period of the wave was sometimes due to a variation in the speed of the oscillograph drum. The author's experiments applied to short circuits following open-circuit conditions; the results following short circuits after full-load conditions would probably be different. If the short occurred at the end of a long length of cable, resonance might easily take place, and the higher harmonics in the short-circuit current wave might be of even greater magnitude than the wave of fundamental frequency. The author had only referred to hard wood clamps for the armature coils; sometimes sheets of mica sewn in canvas bags were used. The opening of a circuit breaker on a D.C. system might easily give rise to violent surges in the system. In the case of a 500-volt three-wire system the sparks from an emery wheel caused a deposit of metallic dust on one of the brush bars of a 500-volt motor. The "earth" opened one circuit breaker, and the capacity and inductance of the remaining motors caused a rise of voltage to take place which broke down a ⅛-in. air gap between the brush connectors on the earthed motor, thereby operating the other circuit breaker. The earth burnt itself out, and the motor could be started again without difficulty. In order to avoid the trouble, the gap between the brush connectors was increased, with the result that the next time the motor earthed, the arc flashed round the commutator by way of the lugs, and, melting the solder, shorted most of the segments. In another case a 5,000-volt 100-H.P. three-phase induction motor was broken down by suddenly switching on; the flash went across a wide gap between the leads of two phases, and set fire to the insulation. The machine did not go to earth, and no further damage was done.

Dr. Rosenberg said that turbo-generators had a comparatively small diameter and a very stiff yoke, beside the air-gap between stator and rotor being large. Hence in case of short-circuiting or even synchronising dead out of phase, hardly any damage was ever done to stator or rotor core, the damage being limited to the windings and couplings. The yoke of a large engine-type generator, on the other hand, with, say, 100 poles, represented, from a mechanical point of view, a beam with a very long span and comparatively weak section. The air-gap between rotor and stator being small, any inaccuracy in erecting would give a large difference in the air-gap of two diametrically opposed poles. The forces coming into play when a "short" or bad synchronising occurred would then not only wreck the winding, which, as a rule, was not so well supported as in a turbo-generator, but also deform the stator to such a degree as to cause the rotor to foul the stator and do serious damage. This actually occurred about six years ago when two 4,000-KW. generators were paralleled dead out of phase. The heavy forces coming into play at the moment of short-circuiting, that is, at the moment when the armature reaction tries to wipe out suddenly the magnetic field, were comparable with the big electrical forces produced when a field current was suddenly switched off. The general opinion was that a shunt-wound D.C. generator at the moment of short circuit lost its excitation, because there was no voltage impressed on the field coils. This was entirely wrong, as the big armature reaction at the moment of short circuit (mainly the demagnetising action of the short-circuit current under the brushes which tried to wipe out the field) caused an *increase* of field current, although there was no outside voltage impressed, and only very gradually, say, in 10 seconds or more, would the field current die away to zero. On the armature, although at the moment of short circuit the voltage between the brushes was zero, a very high voltage might be induced between points of the commutator approximately in the middle between the brushes. If, say, 20 times normal current flowed through the armature conductors, this would give an enormous field at right angles to the main field, and that would set up in the armature, between points which were normally equi-potential, a voltage of about five times the normal. He had no doubt that it was mainly due to this fact that with bad short circuits the arc would sometimes go right round the commutator. It was not only that the current under the brushes was so great that it could not be commutated, and, therefore, an initial arc at the brushes was started; the continuance of the arc was due to the fact that after the commutator bars had passed the brushes, the voltage between two bars would be very much higher than the ordinary working voltage.

Mr. A. R. Everest (B.T.-H. Co.) said that the winding reactance decreased with very high currents, due to tooth and other saturation, so that, with 20 or 30 times full-load current, the reactance would become much smaller than the value determined around full-load current, and the instantaneous short-circuit current might be expected to be still larger on this account. The value of current on steady short-circuit depended on the amount of excitation; for excitations corresponding to full voltage, no load, it might be 1·75 times full-load current. With excitation sufficient for full inductive rated load it might be 2·5 times, and with field strength as used on heavy overloads, it might be three times full-load current. The instantaneous rush of current on a sudden short-circuit depended not on the excitation, but on the actual amount of pole flux, that was, the generated voltage, which was almost constant under the different conditions mentioned. Therefore the ratio between instantaneous and steady short-circuit current values would be much greater if occurring at light loads, and for this reason it seemed preferable to express the values in terms of rated full-load current. He recalled the case of a salient-pole machine with field windings of edge-wound copper strip, which, being accidentally thrown on a short-circuited feeder, flashed across one field coil, leaving a scarred burnt

patch about 4 in. long across the surface of the windings. Undoubtedly, the rotor surges, both in current and voltage, might be very severe. Large alternators should be designed with sufficient reactance to keep the effects of accidental short-circuit within reasonable limits, close regulation being secured with the Tirrill regulator.

Mr. S. J. Watson (Chairman) thought it spoke exceedingly well for the design of d.c. machines, that shunt-wound generators were able to stand such heavy short-circuits, for the appreciable length of time during which the machine was called upon to carry the heavy load before the operation of the circuit-breaker.

Mr. Miles Walker, in reply, said that, regarding the energy stored in the rotor, he did not put down any appreciable damage in the windings to the stored energy. Magnetic energy did not appear as mechanical energy in the stator windings He did not agree that the increase of self-induction would make the current greater. As stated by one speaker, the reactance was greater at higher currents, and this should have been noted in the paper. Generally speaking, very little trouble had been experienced with the rotor windings.

The Design of Turbo Field Magnets for A.C. Generators, with Special Reference to Large Units at High Speeds.

By Miles Walker, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, March 17th*, 1910.)

This paper re-opens the controversy between the salient pole type of field magnet and the cylindrical type. Reasons are given why the latter type is better suited for obtaining the greatest possible output from a given diameter.

The turbo-generator of the future will have to be capable of giving an extremely large output from a diameter which is not excessive, and will have to be constructed in a manner which permits of a high factor of safety. The kilowatt capacity of large units will be as great as 15,000 or 20,000 kw.

Fig. 1 shows a section through the iron parts of a turbo-alternator.

The output of the field magnet is proportional to the product of two factors: The cross-section of the iron of the path indicated by the arrows (fig. 1); and the ampere-turns carried by the copper winding.

The best theoretical arrangement would be a disposition of copper and iron something like that shown in fig. 1, in which the iron and copper are put where they are most useful, and least interfere with

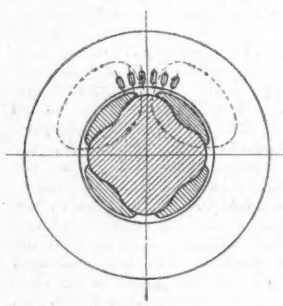


Fig. 1.

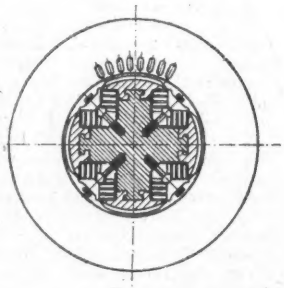


Fig. 2.

the presence of one another. The type of rotor which most nearly approximates to this, will be the one which will give the greatest output in the smallest space.

One of the main considerations which determines the arrangement of iron and copper on a turbo-rotor is the necessity of supporting the parts against the great centrifugal forces. The salient pole at first sight appears to offer very great facilities for supporting the copper winding, because it can be made with a projecting lip all round the pole. Fig. 2 shows the field magnet of one of the four-pole turbo-generators lately described before this Institution.* This is mechanically a very good construction.

When it is decided to go to extremely high peripheral speeds and additional support is required for the independent coils, the type shown in fig. 3 may be employed. Here the coil on each pole consists of four parts wound in slots cut out of a solid steel forging. Or if it is desired to construct the pole of laminations, the type shown in fig. 4 may be employed, and great mechanical strength at the same time obtained. Very successful turbo-generators have been built according to the methods illustrated in figs. 2, 3 and 4.

It will be observed, however, from these figures that there is between all the poles a space which is not utilised at all, and that is the very space where the copper winding should be, according to the ideal arrangement in fig. 1. This space can be utilised to a certain extent for the purpose of ventilation. It is, however, frequently occupied by bronze coil supports which are found necessary to prevent side bulging of the coils.

* G. Stoney and A. H. Law: "High-speed Electrical Machinery," *Journal* of the Institution of Electrical Engineers," Vol. 41, page 300, 1908.

With the coils placed as shown in figs. 2, 3 and 4, the cross-section of the pole is necessarily reduced, and therefore one of the factors of output (No. 1 above) is reduced. It will be seen that the reduction of the total flux of a generator reduces its output in a way that can never be quite compensated for by increasing the ampere-turns, because the capacity of the armature is in any case limited to a

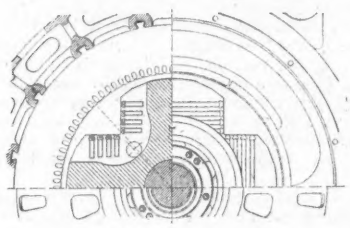


Fig. 3.

definite number of ampere-wires per inch of periphery on account of heating considerations, whereas the flux-carring capacity of the armature iron can be extended by increasing the outside diameter of the punchings.

A type of field magnet which very effectually gets away from the necessity of side supports for the coils is that shown in fig. 5, where each pole consists of a number of round poles placed side by side

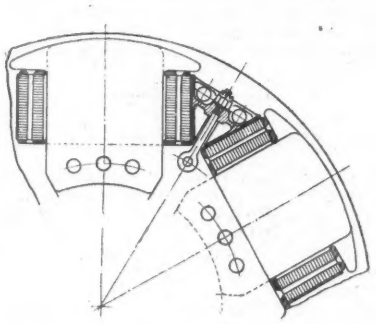


Fig. 4.

on a central boss. This construction has the drawback of still further reducing the cross-section of the iron path, but it leaves a large amount of space available for ventilation.

With the salient pole type the ends of the coils are easily supported by a projection from the ends of the poles. The coils moreover, are comparatively simple in form and cheap to construct, and the length of mean turn is not great for a given cross-section of iron enclosed. The coils can be easily replaced.

The advantage of the cylindrical type with distributed winding, as illustrated in figs. 6 to 9, is that by placing the winding in slots between iron teeth we can utilise a great part of the periphery both for carrying flux and for carrying ampere-turns. In order to obtain a generator of good regulation, it is necessary to have the ampere-turns at no load upon the field magnet greater than the ampere-turns on the armature. Where the iron body of the pole and the iron core of the armature offer very little magnetic reluct-

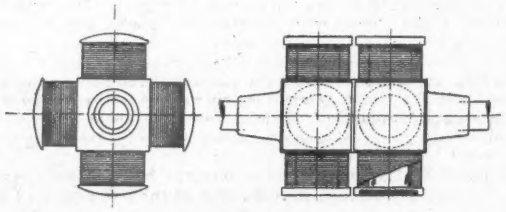


Fig. 5.

ance, it is necessary to introduce into the magnetic circuit some part, such a large air gap, which will offer a large reluctance, and enable the ampere-turns on the field magnet at no load to be of the required amount. It is therefore seen that the interference with the magnetic circuit caused by the slots in fig. 6 is rather beneficial than otherwise, for the flux path being constricted in these teeth, there is a drop in magnetic potential just as there is in an air gap. The teeth and slots may therefore be taken to replace, in some measure, a large air gap; in fact, saturated teeth employed in this manner give an even better characteristic than an air gap. Again, the space taken up by the teeth does not seriously interfere with the space required for the copper, because the iron presents a large surface to which heat can be conducted from the copper, and in

that way enables the copper to be worked at a higher current density than otherwise would be the case.

Thus we see that with the arrangement shown in figs. 7 to 9 the iron and copper, though each, to a certain extent, encroaches upon the space required for the other, mutually assist one another. It will be seen, too, in fig. 6, that the iron below the slots offers such a large cross-section for the flux path that we can easily spare space for a number of large holes which traverse the field magnet from one end to the other, and supply air to a number of radial air ducts.

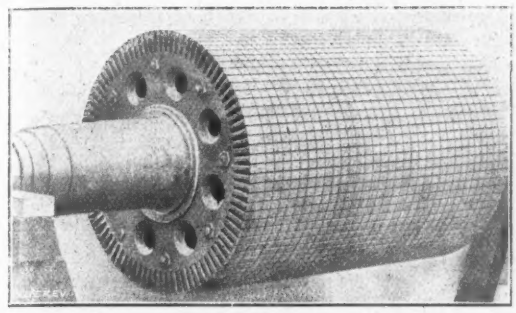


Fig. 6.

Thus with the cylindrical field magnet we obtain a very large cooling surface on the insulation of the copper winding by which the heat can be carried from the copper to the iron, and also very large surface within the ventilating ducts, by which the heat can be carried from the iron to the air.

It is found in practice that copper placed in such slots can carry twice as many ampere-turns per square inch as copper in a wound coil 2½ in. in thickness. There is a distinct advantage in supporting comparatively small sections of copper winding in independent slots, because by so doing one can preserve a high factor of safety in the

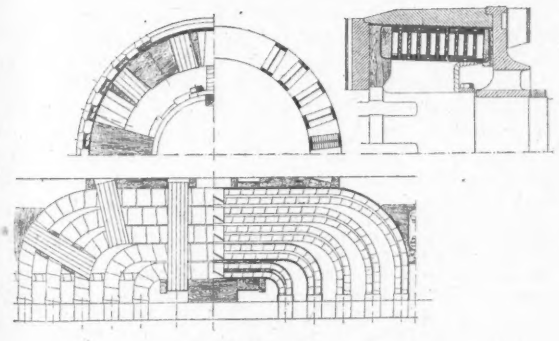


Fig. 7.

pressures thrown on the insulating materials, and by avoiding a great number of successive layers of insulation, one is able to avoid troubles due to shrinkage of the insulating material.

A drawback to be set off against this is that the length of mean turn for a given area of iron enclosed is greater than in the salient-pole construction.

The main difficulty with the early cylindrical field magnets having windings distributed in slots was the supporting and cooling of the connections from one slot to another at each end of the rotor.

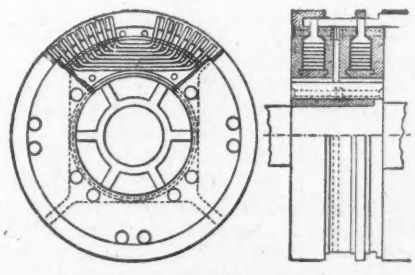


Fig. 8.

Various methods have been adopted for making these end connections. In one type the connections form a barrel winding, similar to that used on D.C. armatures. This type has the following advantages: All the conductors are made of the same shape, and the connections between them are very easily made by means of thimbles placed over the ends. The insulation of the winding can be carried out very effectually, and when well constructed and secured by wire or solid metal rings placed over the end connections, it preserves its balance extremely well.

Another type is shown in fig. 7. This consists of concentric coils, and is, perhaps, the best type of winding to employ where the exciting current is small (say 50 to 100 amperes supplied at a high voltage), and where, therefore, a great number of comparatively small conductors must be placed in each slot. This winding may be supported by a metal ring placed over the ends, as shown, or by means of a sheath strengthened by numerous rivets or bolts.

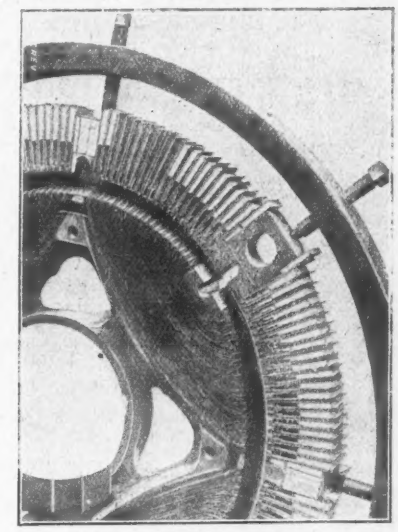


Fig. 9.

Another method of supporting the end connections is shown diagrammatically in fig. 8. Here the end connections consist of copper straps bent into the required shape, insulated from one another, and assembled so as to form a solid fan-shaped block. Four of these blocks are mounted on a saddle, and V-shaped grooves are cut as shown in fig. 9. The whole is then assembled between steel cheeks having V-shaped projections, mica V-rings being placed in the grooves, just as in the construction of a D.C. commutator. A great number of field magnets have been constructed in this manner on machines intended for very high peripheral speeds, and they have proved very satisfactory, both mechanically and electrically.

The important points to be aimed at in the designing of the winding of turbo-generator field magnets are as follows:—

1. Although the field magnet is excited at low voltage, the insulation must be carried out with the very greatest care. It is found that the dust which settles on the revolving parts of turbo-generators may be so highly compressed by centrifugal force, that it becomes a much better conductor than the dust found on low-speed machines.

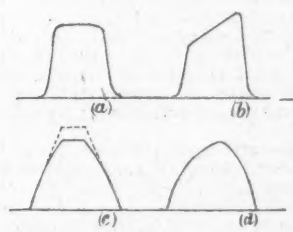


Fig. 10.

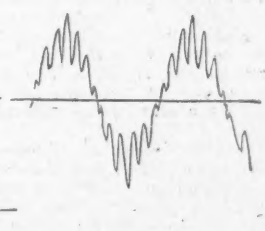


Fig. 11.

2. The insulation should be of such a nature that it does not permit the conductors to move in a radial direction after it has become dry.

3. Allowance must be made for expansion and contraction of the copper.

4. Provision must be made for the cooling of the end connectors.

5. The design should be such that a repair of one part of the winding can be carried out with as little disturbance as possible of the remainder of the winding.

The flux distribution at no load on the face of the armature of a salient-pole macaine is shown in fig. 10 (*a*). At full load the field becomes distorted, as shown in fig. 10 (*b*), and if the armature is constructed with open slots, there is a tendency for the peak in the wave of the field form to produce ripples in the E.M.F. wave-form. These ripples, though of little consequence in the operation of most alternating-current machinery, may give rise to dangerous voltages when the generator is feeding a large system of cables, whose capacity happens to give to the system a natural period of vibration corresponding, or nearly corresponding, with the fre-

quency of the ripples. For this reason armatures provided with open slots are not as good as armatures with semi-enclosed slots unless the number of slots per pole is very great, the air-gap very long, or the field form entirely free from peaks. Ripples which on a no-load wave-form are scarcely perceptible may, when the capacity of the circuit assumes a certain critical value, be exaggerated, so that the E.M.F. wave-form assumes a shape like that illustrated in fig. 11. In this case the form factor may be very greatly augmented

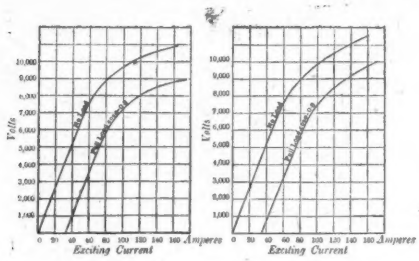


FIG. 12.—SALIENT POLE SATURATION CURVES.

FIG. 13.—CYLINDRICAL FIELD SATURATION CURVES.

and a serious pressure thrown on the cables. An E.M.F. wave-form closely resembling a sine wave-form and free from ripples both at no load and on full load is of considerable commercial importance.

The field-form of the cylindrical type of field magnet with a distributed winding is shown in fig. 10(*c*). The dotted line shows the distribution of magneto-motive force along the air-gap. The full line shows the form taken by the field. It will be seen that owing to the saturation of the teeth near the centre of the pole the corner of the field-form is nicely rounded off. Fig. 10(*d*) shows the full-load field-form. Here again we have a nicely rounded curve free from elevated peaks.

In order to make an ordinary alternate-current generator regulate well, it is necessary to have a large ratio between the ampere-turns on the field and the ampere-turns on the armature. With turbo-generators it is not usual to have this ratio greater than two; in many turbo-machines it is considerably less. In these cases it is usual to saturate the field magnet to a fairly high point, so that when the load is thrown off, the extra ampere-turns in the exciting coils, which were necessary to keep up the voltage on load, shall not be able to create too great a rise in voltage. There is considerable danger in employing a very highly saturated field magnet, because it is always difficult to be sure of the quality of iron, and if the saturation is carried too far, it may be found impossible to obtain the voltage of the machine on heavy loads at a low power factor.

It is important in this connection to consider at what part of the pole the saturation occurs. If the generator is of the salient-pole construction and the saturation occurs at the root of the pole, there is much more danger of being unable to obtain full voltage than if the saturation occurs in teeth distributed near the periphery of the field magnet. The reason of this is that the leakage is greater with the salient pole than with the cylindrical type. The leakage flux from the pole combines with the working flux in producing the saturation, and as the leakage flux is almost proportional to the ampere-turns on the pole, we increase the leakage and consequently the saturation at the same time that we increase the field current.

Fig. 12 shows the shape of the saturation curve of a machine with salient poles both at no load and at full load, where the saturation has been designed to be rather excessive. It will be seen that at heavy load on a low power factor the saturation curve is almost asymptotic to a horizontal line, so that though the field current may be raised to very high values, the voltage cannot be increased beyond a certain point. Fig. 13 shows the shape of the saturation curve of a generator with a cylindrical field with highly saturated teeth both at no load and on a low power-factor load. Here the curve never becomes asymptotic to a horizontal line, because at the worst the space occupied by the copper and teeth will operate as a long air-gap, and there is no saturation in the body of the pole.

An important advantage of the cylindrical type of field magnet is that it is easy to arrange it so as to embody the compensating principle described on page 402, Vol. 34, of the *Journal* of this Institution, and make the armature reaction strengthen the field. This enables good regulation guarantees to be made without necessitating a very great ratio between the ampere-turns on the field and the ampere-turns on the armature. With this type of machine it is possible to get good regulation (2 per cent. at unity power factor and 12 per cent. at 0·8 power factor) even with the ampere wires per inch of periphery as high as 1,000. It is also possible to employ a flux density in the air-gap as high as 11 Kapp lines per square inch without incurring any trouble from unbalanced pull.

An important feature of this type of rotor is that while it gives good inherent regulation at ordinary power factors, the armature current on short circuit can be made quite small—that is, 1·5 times full-load current for the permanent value, and about 10 times full-load current for the instantaneous value.

THE CLASSIFICATION AND FILING OF TECHNICAL INFORMATION.

By C. H. R. THORN, A.M.I.E.E.

THIS article is written with a view to giving "something to go on" to anyone starting, or thinking of starting, the filing of information likely to be of use to him in the future, whether culled from technical papers or elsewhere, and describes the system which the writer has had in use for some years and which has been found very satisfactory.

The actual filing receptacle used by the writer is one of the Stolzenberg Co.'s small oak cabinets, about 3 ft. high × 18 in. wide, with rolling shutter front and 12 removable shelves placed about 2 in. apart. Any box or cabinet with shelves on which filing folders can be placed conveniently, and divided up into groups, will, of course, do, and the writer has recently come across a firm who make tin or leather cases fitted with convenient shelves or partitions, which would be useful for anyone travelling about much.

The process of filing is as follows:—When an article or piece of information which it is desired to keep for future reference is noticed in, say, a technical paper, it is cut or torn out, the sheets being preferably torn out complete for convenience in filing, although if two articles which it may be desired to keep overlap on to one sheet, it may be necessary to cut it. The information so extracted is filed in the usual folders of cardboard or fibrous material, several forms of which are on the market, a type having facilities for fixing the contents being used preferably. Separate folders, of different colours, are used for different subjects, as shown in the table, and new cuttings are filed on the top of those previously filed.

The cuttings are numbered in the right-hand top corners in the order in which they are inserted, *i.e.*, No. 1 at the bottom, this numbering being conveniently done with red or blue pencil, so that the numbers can at once be seen when looking for any particular one. When any article covers more than one sheet, *each* sheet is preferably numbered in this way, each of course with the same number, and it will also be found convenient to give the top sheet a distinguishing mark such as a circle round its index number. This numbering of *all* sheets, although apparently a small matter, will be found to be a great advantage when a folder becomes bulky and the leaves are being turned over to find a particular number. Filed on the top of the cuttings in each folder are one or more sheets of foolscap, on which a note is made, in the form of a heading as comprehensive as possible, of each article as it is filed, together with its index number. Here, again, it will be found a great help, when looking through such a list in a bulky folder, if the important words of each heading are underlined, or otherwise made conspicuous; although a small matter, this makes a considerable difference in the eye-labour involved when looking through the lists for particular headings. The following half-dozen headings, taken from the writer's "Steam Engine" folder, are given as an illustration of this:—

1. Comparison of *Steam Consumption* of Marshall slow-speed and Willans H.S. Engines (from tests).
2. Sight-feed *Lubricators* (various).
3. Instructions for *Erection* of Belliss H.S. Engines.
4. *Balancing* of Engines.
"*High-Speed Engines.*" Paper by W. Crawford to Assoc. of Engineers-in-Charge, March 9th, 1904. (Box 2.)
5. *Steam Consumptions* of Willans Engines.

These headings, it will be observed, include one the subject of which is not filed in the folder, as it is obviously convenient to use this filing system for references to articles, &c., which have not been actually filed; whilst practical information in the form of notes is also conveniently inserted in the folders, thus doing away with the need for numerous note-books, in which particular information is usually difficult to find after the lapse of a year or two. Entries such as that between numbers 4 and 5 above are preferably made in red ink, in order to distinguish them readily from the others, whilst they of course have no numbers.

The folders are arranged in groups according to the general

nature of the information they contain, the subject matter, and therefore the grouping, depending upon the particular kind of information which it is desired to file in individual cases. For general electrical engineering purposes, the headings and groupings shown in the table below will be found convenient, this being the arrangement which has been in use by the writer for some years.

TABLE SHOWING CLASSIFICATION OF SUBJECTS.

Main grouping.	Shelf.	Sub-grouping.		Folder headings.	Colours
Generating plant.	1	Stationary plant	*a*	Spare folder for unfiled matter	Red
			b	Boilers, chimneys, &c.	Grey
			c	Boiler accessories	Yellow
			d	Condensing plant	Blue
			e	Pipework	Green
			f	Gas producers	Red
	2	Prime movers	*a*	Steam engines	Red
			b	Steam turbines	Grey
			c	Gas engines	Yellow
			d	Oil engines	Blue
			e	Water-power plant	Green
	3	Electrical machinery	*a*	D.C. generators	Red
			b	A.C. ,,	Grey
			c	Batteries, balancers and boosters	Yellow
			d	Testing of electrical machinery	Blue
	4	Complete plants	*a*	Lighting and power stations	Red
			b	Tramway stations	Grey
Distribution and control.	5	—	*a*	Switchgear	Red
			b	Instruments	Grey
			c	Transformers	Yellow
			d	Overhead transmission	Blue
			e	Cables and mains	Green
			f	Meters	Red
Applications.	6	Lighting	*a*	Lighting systems, wiring &c.	Red
			b	Lamps and accessories	Grey
			c	Arc lamps	Yellow
			d	Projectors	Blue
			e	Electricity *v.* gas	Green
	7	Power (works)	*a*	D.C. motors	Red
			b	A.C. ,,	Grey
			c	Machine driving	Yellow
			d	Cranes	Blue
			e	Complete works equipments	Green
	8	Power (Miscellaneous)	*a*	Pumps	Red
			b	Fans	Grey
			c	Electricity in mines	Yellow
			d	Heating and cooking	Blue
			e	Telegraphy and telephony	Green
			f	Miscellaneous applications	Red
	9	Traction (equipment)	*a*	Overhead work	Red
			b	Track	Grey
			c	Rolling stock	Yellow
			d	Accessories	Blue
	10	Traction (General)	*a*	Systems	Red
			b	Signalling	Grey
			c	Regeneration and brakes	Yellow
			d	Motor-cars (electric)	Blue
			e	General notes	Green
General information.	11	Technical	*a*	Tools	Red
			b	Buildings and structures	Grey
			c	Miscellaneous machinery	Yellow
			d	Accidents	Blue
			e	Books	Green
	12	Commercial, &c	*a*	Organisation and management	Red
			b	Legal and Parliamentary	Grey
			c	Financial and commercial	Yellow
			d	Company reports, &c.	Blue
			e	Foreign notes	Green
			f	Hire-purchase	Red

The shelves in the cabinet have labels attached to them giving the sub-group headings, whilst the top shelf of each main group has another label giving the group heading, as shown in fig. 1, which shows the general appearance of the cabinet when open. A convenient form of brass-framed label can be obtained from the Stolzenberg Co., and probably elsewhere, these labels having clips for attaching to the shelves. It will be seen, on referring to fig. 1, that the main-group labels on the left form "landmarks" which are a considerable help in locating any particular folder, so that after a while it becomes unnecessary actually to read the labels. This is particularly useful in saving time when sorting out and filing an accumulation of papers. A further convenience is to have fixed on each shelf, near the front edge, strips cut from the covers of spare folders, of the various colours used, a convenient size for these strips being about 1 in. × ½ in. These are arranged in the order in which the folders are filed, and marked with the headings of

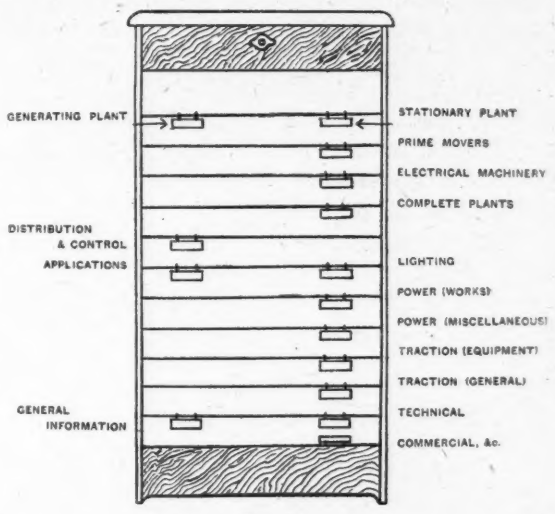


FIG. 1.

the folders, the arrangement of these labels on the "Electrical machinery" shelf being shown, as an example, in fig. 2.

In conclusion, the particular arrangement and grouping described is that adopted by the writer to suit his own convenience, but the system, so far as the headings of folders,

D.C. GENERATORS.	A.C. GENERATORS.	BATTERIES, BOOSTERS, &c.	TESTING.
Red.	Grey.	Yellow.	Blue.

FIG. 2.

&c., is concerned, can be altered to suit individual requirements, without altering its main characteristics; and it is hoped that this description will at least be a help to anyone who has not yet started keeping information in an easily accessible condition.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

6,312. "Improved system of automatic generation of electricity for motor-cars." R. F. HALL. March 14th.

6,316. "Improvements in or connected with the controlling of aerial and other vessels and equivalently operated apparatus by wave-transmitted electricity." T. E. R. PHILLIPS. March 14th.

6,368. "Improvements in electric switches." ADAMS MANUFACTURING CO., LTD. (Cutler-Hammer Manufacturing Co., United States.) March 14th. (Complete.)

6,380. "Improvements in apparatus for facilitating the insertion of incandescent electric lamps in lace or open-work nets or bags in which they are suspended during transit, in order to prevent injury." H. HILL. March 14th.

6,397. "Improved support for incandescent filaments in electric glow lamps." WOLFRAM LAMPEN AKT.-GES. (Date applied for under Sec. 91 of the Act, March 13th, 1909, being date of application in Germany.) March 14th. (Complete.)

6,403. "Improvements in and relating to the driving of electric rail vehicles." AKT.-GES. BROWN-BOVERI ET CIE. (Date applied for under Sec. 91 of the Act, April 1st, 1909, being date of application in Germany.) March 14th. (Complete.)

6,481. "Improvements in connections for terminal ends of electric cables." R. F. HALL. March 15th.

6,482. "Improvements in electric generators for motor-cars." R. F. HALL. March 15th.

6,483. "Improvements in electric wiring for supplying current for motor-cars (conduit system)." R. F. HALL. March 15th.

6,523. "Improved alloy for electric soldering tools and like purposes." REGINA BOGENLAMPENFABRIK G.m.b.H. (Date applied for under Sec. 91 of the Act, May 4th, 1909, being date of application in Germany.) March 15th. (Complete.)

6,531. "Improvements in the electric control of engines, dynamos and batteries." L. SUNDERLAND and G. C. PILLINGER. March 15th.

6,535. "Improvements in controlling devices for electric motors." T. BARNARD and G. C. EDWARDS. March 15th. (Complete.)

6,586. "Improvements in and or connected with multiple arc electric lamps." H. P. BLECKLY. March 15th.

6,553. "Improvements in electric welding." S. JEVONS and V. D. GREEN. March 15th.

6,561. "Device and method whereby automatic registration is made of the number of times a subscriber's telephone is used." A. J. Newton. March 16th.

6,566. "Improvements in sparking plugs for internal explosion engines." R. F. Hall. March 16th.

6,589. "New or improved means for supporting electric wiring conduits in position." H. D. Staniar and A. E. Clegg. March 16th.

6,594. "Improvements in balancing apparatus for three-wire and the like electrical distributing systems." C. Turnbull, Jun. March 16th. (Complete.)

6,596. "Improvements in electrolytic apparatus having a liquid annular anode." Schott & Gen. (Application for Patent of addition to No. 14,288/1909. (Date applied for under Sec. 91 of the Act March 30th, 1909, being date of application in Germany.) March 16th. (Complete.)

6,597. "Improvements in electrolytic apparatus having a liquid anode." Schott & Gen. (Application for Patent of addition to No. 14,288/1909. (Date applied for under Sec. 91 of the Act, March 30th, 1909, being date of application in Germany). March 16th. (Complete.)

6,624. "Improvements in or relating to dynamo-electric machines." T. von Sweigbergk. March 16th.

6,632. "Improvements relating to electrical sound-producing horns. H. Lucas and W. H. Edwards. March 16th.

6,633. "Improvements in and relating to circuit breakers and the like." M. B. Field and Ferranti, Ltd. March 16th.

6 634. "Improvements in dynamo-electric machines of the homopolar type." F. H. Loring. March 16th.

6,650. "High frequency ignition apparatus for internal combustion engines." H. J. Haddan. (L. B. Lesperance, United States.) March 16th. (Complete.)

6,653. "Improvements in magneto electric ignition machines." Firm R. Bosch. (Date applied for under Sec. 91 of the Act, May 18th, 1909, being date of application in Germany.) March 16th. (Complete.)

6,654. "Improvements in automatic telephone exchanges." Siemens Bros. and Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) March 16th. (Complete.)

6,658. "Improvements in holders for the filaments of incandescent electric lamps." F. Salzer. (Date applied for under Sec. 91 of the Act, March 19th, 1909, being date of application in Hungary.) March 16th. (Complete.)

6,666. "Improvements in and connected with electrical systems intended more especially for the lighting, heating and ventilating of railway trains." J. Stone & Co., Ltd., and A. H. Darker. March 16th.

6,667. "Improvements in and relating to electric energy meters." British Thomson-Houston Co., Ltd., and C. R. D'Arcy. (Application for Patent of Addition to No. 6,565, 1909. Date applied for under Rule 13, September 20th, 1909. An invention comprised in Application No. 6,365, dated September 20th, 1909.) March 16th. (Complete.)

6,668. "Improvements in and relating to protective devices for electrical transmission and distribution systems." British Thomson-Houston Co., Ltd., and E. B. Wedmore. (Date applied for under Rule 13, October 18th, 1909. An invention comprised in application No. 17,031, dated October 18th, 1909.) March 16th. (Complete.)

6,681. "Improvements in electric trolley heads." L. A. Dixon. March 17th

6,704. "Improvements in systems of electric wiring and apparatus relating thereto." G. Charlton. March 17th.

6,706. "Improvements in machines for the manufacture of flexible metallic tubes, or for armouring insulated electric and other cables." W. A. Marshall. March 17th. (Complete.)

6,719. "Improvements relating to automatic make-and-break contact devices for electric circuits." E. A. Bridge. March 17th. (Complete.)

6,743. "Improvements in electrically-operated signalling for railways or tramways." J. Boot and R. W. Tarrant. March 17th.

6,746. "Improvements in or connected with electric accumulators." E. M. Gatinaud. March 17th. (Complete.)

6,766. "Improvements in electrical apparatus for lighting motor-car vehicles, railway carriages and the like." Blériot, Ltd. (Société Phi France.) March 17th. (Complete.)

6,768. "Improvements in or relating to electric furnaces and method of charging the same." Stora Kopparbergs Bergslags Aktiebolag. (Date applied for under Sec. 91 of the Act, March 19th, 1909, being date of application in Sweden.) March 17th. (Complete.)

6,782. "Improvements in or relating to recording galvanometers and other instruments operating with a very small turning moment." Campagnie pour la Fabrication des Compteurs et Materials d'Usines a Gaz (Date applied for under Sec. 91 of the Act, March 15th, 1909, being date of application in France.) March 17th. (Complete.)

6,792. "Improvements in and relating to electric circuit interrupting devices and the like." British Thomson-Houston Co, Ltd., and E. B. Wedmore. March 17th.

6,814. "Improvements in and connected with electric road lamps." G. Fuller, B. J. Moore and L. Fuller. March 18th.

6,825. "Improvements in and relating to controllers for electric motors." W. J. F. Neave. March 18th. (Complete.)

6,862. "Improvements in electric advertising signs." G. Sweetser. March 18th.

6,865. "Improved apparatus for shortening electric waves." M. Pizzuti and C. Ferrari. March 18th. (Complete.)

6,867. "Improvements in motor controllers." Adams Mnfg. Co., Ltd. (Cutler-Hammer Mnfg. Co., United States.) March 18th. (Complete.)

6,868. "Improved three-phase current arc lamp." E. Konecke. (Date applied for under Sec. 91 of the Act, March 19th, 1909, being date of application in Germany.) March 18th. (Complete.)

6,870. "Improvements in sparking plugs." J. E. Anger. (W. E. Anger, United States.) March 18th.

6,871. "Improvements relating to calculating devices for electrical quantities." M. I. Williams-Ellis. March 18th.

6,875. "Improvements in semi-automatic telephone exchanges." Siemens and Halske Akt-Ges. (Date applied for under Sec. 91 of the Act, March 18th, 1909, being date of application in Germany.) March 18th.

6,876. "Improvements in telegraphic relays." A. Damaskinos. March 18th.

6,881. "Improvements in and connected with current collectors for overhead electrical tramways and light railways." F. W. Tucker. March 18th.

6,894. "Improvements in and relating to electric measuring instruments." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) March 18th.

6,895. "Improved system for use in long-distance telephony." A. Petersen and G. Sem. (Date applied for under Sec. 91 of the Act, March 25th, 1909, being date of application in Norway.) March 18th. (Complete.)

6,937. "Improvements in and relating to the control of electric supply systems." H. M. Taylor and R. H. Scotson. March 19th.

6,962. "Improvements relating to the driving of magneto-electric machines for starting internal combustion engines." L. L. Bellem and G. J. B. Breguras. (Date applied for under Sec. 91 of the Act, March 25th, 1909, being date of application in France.) March 19th. (Complete.)

6,964. "Connections for semi-automatic telephone exchanges." Siemens and Halske, Akt.-Ges. (Date applied for under Sec. 91 of the Act, March 20th, 1909, being date of application in Germany.) March 19th.

Worksop Lighting.—The U.D.C. has received from the L.G.B. sanction to a loan of £1,500 for electricity purposes, without the holding of a local inquiry.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Arrangements for Charging and Discharging Electric Accumulators. A. M. Taylor. 24,648. November 17th. (Cognate applications: 1,959, 1909; 9,666, 190); 10,913, 1909; 11,958, 1909; 13,950, 1909; and 13,701, 1909.)

1909.

Telephone Exchanges. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 25,833. November 9th.

Telephone Exchanges. Siemens & Halske Akt.-Ges. 28,383. December 4th. (Date applied for under International Convention, December 5th, 1908.)

Combined Magneto and Coil Sparking Mechanism for Internal-Combustion Engines. C. A. Vandervell. 684. January 8th.

Electrical Telegraphic Typewriting Machines. L. Cerebotani. 1,551. January 21st. (Date applied for under International Convention, January 22nd, 1908.)

Electrical Power Transmission. R. Thomas. 1,582. January 21st. (Cognate application, No. 14,560, 1909.)

Multiple Electric Switches and Automatic Circuit-Breakers, especially Applicable to Motor Starters. P. S. Brook and J. A. Hirst. 4,093. February 19th. (Cognate application, No. 16,678, 1909.)

Electromagnetic Vibrator for Local Application to the Person. A. Rosenberg. 4,133. February 19th.

Method of and Apparatus for Controlling the Voltage of Dynamo-Electric Machinery, especially applicable to Variable-Speed Generators. W. Stansfield and J. J. Hatt. 4,181. February 20th.

Electrolytic Devices Suitable for Use as or in the Construction of Meters, Switches and other Apparatus. W. B. Thorpe. 4,258. February 20th.

Relay for Telephone and Weak Alternating Currents. A. Nikiforoff. 4,480. February 2.rd.

Maximum-Current Indicator for Electricity. T. McClelland and Ferranti, Ltd. 5,459. March 6th.

Electric Sparking Plugs. E. J. Twigg. 5,955. March 11th.

Starting of Electric Induction Alternate-Current Motors. Siemens Bros. Dynamo Works, Ltd., and M. Kloss. 6,956. March 23rd.

Trolley Retrievers for Electric Cars. J. Eccles and W. E. Hadfield. 11,326. May 13th.

Electrical Fuse Carriers. W. T. Henley's Telegraph Works Co. and W. H. Nichols. 12,744. May 29th.

Alternating-Current Generators. W. F. Grafton and Johnson & Phillips, Ltd. 13,039. June 3rd.

Electric Motor. C. H. Prott. 15,917. June 30th.

Electrically-Controlled Pneumatic Dispatch Tubes, Cash Railways and the like. C. W. Bluemel, E. A. Bluemel, F. H. Bluemel, and P. R. Shill. 16,004.

Electric Hand Lamps. H. B. Jenkins. 20,881. September 18th.

Electrodes for Arc Lamps. Geb. Siemens & Co. 21,374. September 18th. (Date applied for under International Convention, October 5th, 1908.)

Electric Arc Lamps. E. Christoph and H. Klein. 22,768. October 6th.

Process for Utilising the Spongy Zinc Obtained Electrolytically. P. Sanna. 24,431. October 2.th.

Electrically-Reset Gravity Escapement. W. D. Walden. 24,632. October 27th.

Sparking Plugs for Internal-Combustion Engines. Firm of Robert Bosch. 25,236. November 2nd. (Date applied for under International Convention, July 8th, 1909.)

Electric Fuse Fittings. Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke Ges.) 25,738. November 8th. (Application for Patent of Addition to No. 8,263, 1909.)

Apparatus and Methods for Generating Alternating Currents. J. L. Milton. 27,033. November 20th. (Date applied for under International Convention, January 30th, 1909.)

Regulating Devices for Direct-Current Dynamos. Fried. Krupp Akt.-Ges. 27,245. November 23rd. (Date applied for under International Convention, March 18th, 1909.)

Telephone Exchanges. Siemens & Halske Akt.-Ges. 28,825. December 9th. (Date applied for under International Convention, December 12th, 1908.)

Sparking Plugs for Internal-Combustion Engines. Firm of Robert Bosch. 30,049. December 23rd. (Date applied for under International Convention, August 25th, 1909.)

1910.

Insulators for High-Tension Electricity Conductors. Franz Clouth Rheinische Gummiwaren Fabrik. 1,009. January 14th. Date applied for under International Convention, September 29th, 1909.)

Connections of Telephone Apparatus. Siemens & Halske Akt.-Ges. 999. January 14th. (Date applied for under International Convention, January 19th, 1909.)

Humours of the Gas Business.—Our American contemporary *Electrocraft* quotes the following extracts from letters received by the San Francisco Gas Co., which indicate that "our gas friends are not denied their little compensations for the troubles of life":—

S. F. Gas and Electric Co.

Gentlemen:—I wish that you would send a gas leak at your meter.

From a Chinaman:

Your man must please come fix; have bad gas breath.

From another Chinaman:

Please you call fix metter; heap stink.

From still another:

Please call make more gas in mettle; all run out.

Yet again: My gas meter is out of order; also my neighbour Mr. Schmidt. Will you please send somebody to fix them.